CENTER FOR NUTRITION POLICY AND PROMOTION

Family Economics and Nutrition Review

Feature Articles

Research Brief

Research Summaries

Regular Items

UNITED STATES DEPARTMENT OF AGRICULTURE
Volume 10, Number 4
1997

Editorial Board

Editor
Joan C. Courtless

Managing Editor
Jane W. Fleming

Family Economics and Nutrition Review is written and published each quarter by the Center for Nutrition Policy and Promotion, U.S. Department of Agriculture, Washington, DC.

The Secretary of Agriculture has determined that publication of this periodical is necessary in the transaction of the public business required by law of the Department.

Family Economics and Nutrition Review is indexed in the following databases: AGRICOLA, Ageline, Economic Literature Index, ERIC, Family Studies, PAIS, and Sociological Abstracts.

Family Economics and Nutrition Review is for sale by the Superintendent of Documents. Subscription price is $10.00 per year ($12.50 for foreign addresses). Send subscription orders and change of address to Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954. (See subscription form on p. 71.)

Original manuscripts are accepted for publication. (See "guidelines for authors" on back inside cover). Suggestions or comments concerning this publication should be addressed to: Jane W. Fleming, Managing Editor, *Family Economics and Nutrition Review*, Center for Nutrition Policy and Promotion, USDA, 1120 20th St., NW, Suite 200 North Lobby, Washington, DC 20036. Phone (202) 606-4816.

Feature Articles

Research Brief

Research Summaries

Regular Items

Volume 10, Number 4
1997

Trends in Food and Nutrient Intakes by Adults: NFCS 1977-78, CSFII 1989-91, and CSFII 1994-95

Cecilia Wilkinson Enns
Joseph D. Goldman
Annetta Cook

Beltsville Human Nutrition Research Center
Agricultural Research Service

Evaluations of diet quality and tracking changes in the diet over time have many useful applications, including policy formation, program planning, and targeting appropriate nutrition education messages. CSFII 1994-95 data on food and nutrient intakes by adults were used to examine diet quality in 1994-95 and changes since 1977-78. The largest changes were decreased consumption of whole milk and increased consumption of grain products, especially grain mixtures; bananas; meat, poultry, and fish mixtures; beer and ale; fruit drinks and ades; and soft drinks. In general, the nutrients that were below the RDA in 1994-95 are the same nutrients that were below the RDA in 1977-78. In 1994-95, intakes of magnesium and zinc were below the RDA for both women and men. Women's intakes were also below the RDA in vitamin B_6, vitamin E, and calcium. Future increases in whole grains, fruits, dark green vegetables, legumes, nonfat or lowfat dairy products, and lean meats and decreases in fats and sugars are desirable.

In accordance with the National Nutrition Monitoring and Related Research (NNMRR) Act of 1990 (P.L. 101-445), the NNMRR Program (NNMRRP) monitors the nutritional status of the U.S. population. As a cornerstone of the NNMRRP, USDA surveys such as the Continuing Survey of Food Intakes by Individuals (CSFII) provide up-to-date information on food intakes by Americans for use in policy formation, regulation, program planning and evaluation, education, and research. For example, CSFII data have been used to evaluate the impact of food fortification on nutrient intakes, to estimate exposure to pesticide residues and other contaminants from foods, and to target nutrition programs to those who need them most. CSFII data are essential for monitoring changes over time in the food choices Americans make and the adequacy of their diet.

This article contains information from the first 2 years of the 1994-96 Continuing Survey of Food Intakes by Individuals (CSFII), conducted by the Agricultural Research Service (ARS) of the U.S. Department of Agriculture (USDA). Some comparisons are made between intakes in the CSFII 1994-95 and intakes in the Nationwide Food Consumption Survey (NFCS) 1977-78 and the CSFII 1989-91. Methods and comparability of the data from the three surveys are discussed briefly in the "Design and Methods" section below.

Mean intakes and percentages of individuals using foods from 12 food groups and 29 selected subgroups are presented for women (tables 1 and 2, pp. 4 and 5) and men (tables 3 and 4, pp. 6 and 7) age 20 years and over who participated in the NFCS 1977-78, CSFII 1989-91, and CSFII 1994-95. Some trends in food intakes that can be traced from the NFCS 1977-78 through the CSFII 1989-91 to the CSFII 1994-95 are highlighted in table 5, p. 8 (see section on "Design and Methods" regarding the definition of a trend). The effect of analyzing food group intakes with grain mixtures and meat mixtures broken down is shown in tables 6 and 7, pp. 8 and 9 and figure 1, p. 10.

Intakes of energy and nutrients as percentages of the Recommended Dietary Allowances (RDA) are presented in table 8, p. 11. Figure 2, p. 12, shows trends in intakes of fat and carbohydrate from 1977-78 to 1994-95. Saturated fat, cholesterol, and dietary fiber intakes are discussed.

Design and Methods

The recently completed CSFII 1994-96, popularly referred to as "What We Eat in America," was conducted by Westat, Inc. (Rockville, MD) under contract to USDA's Food Surveys Research Group (FSRG), Agricultural Research Service (ARS). In each of the 3 survey years, a nationally representative sample of noninstitutionalized individuals residing in the United States provided, through in-person interviews using a 1-day dietary recall, food intakes on 2 nonconsecutive days and health-related information.

Some estimates from the NFCS 1977-78 and the CSFII 1989-91 are compared with estimates from the first 2 years of the CSFII 1994-96. Some differences exist between the three surveys in sampling and methodology. Detailed information on the methodology of each survey is available elsewhere *(13-17)*.

In 1994-96, the target population was noninstitutionalized individuals in all 50 States; in 1977-78 and 1989-91, the target population covered only the 48 conterminous States. The 1994-96 survey included an oversampling of the low-income population; earlier surveys included separate supplemental samples for the low-income population. In the summer, fall, and winter quarters of the NFCS 1977-78, in households with more than one individual 19 years or over, one-half of the individuals in that age group were asked to participate. In the CSFII 1988-91, all individuals in sample households were eligible. CSFII 1994-96 data were collected from selected individuals within each household. The 1994-96 survey provides a proportionately larger sample in selected sex-age categories, specifically young children and elderly people.

In the NFCS 1977-78 and the CSFII 1989-91, dietary information was collected on 3 consecutive days using a 1-day dietary recall and a 2-day dietary record. In the CSFII 1994-96, dietary data were collected by means of 1-day dietary recalls on 2 nonconsecutive days (3 to 10 days apart). The 1-day recall was modified for the CSFII 1994-96 to include multiple passes through the list of all foods and beverages recalled by the respondent in order to maximize the amount of information collected. The multiple-pass approach and its development are described in detail elsewhere *(3, 5, 13)*. The procedure has respondents provide a list of all foods eaten the previous day, using any recall strategy they desire. Then interviewers get a more detailed list by probing for additions to food and giving respondents an opportunity to recall food items initially forgotten. In a third pass, the interviewers review with the respondents the list of food they reported to stimulate more reports of food and eating occasions.

In order to track trends over time from surveys with different numbers of days of dietary information, tables and figures comparing food and nutrient intake estimates among the surveys are based on only the first day's data collected from each individual. All estimates are weighted to be nationally representative.

In addition to the changes outlined above, the USDA nutrient data base was updated for each survey to reflect changes in foods on the market and also to incorporate improved nutrient values.

Table 1. Mean intakes per individual from selected[1] food groups and standard errors of the mean, women 20 years and over, 1 day, NFCS 1977-78, CSFII 1989-91, and CSFII 1994-95

Food group[2]	1977-78		1989-91		1994-95	
	Mean	(SEM)	Mean	(SEM)	Mean	(SEM)
			Grams			
Total grain products	177	(2.4)	234	(5.8)	255	(5.3)
Yeast breads and rolls	48	(.5)	45	(.9)	45	(1.0)
Cereals and pasta	42	(3.5)	63	(3.2)	64	(2.6)
Ready-to-eat cereals	7	(.2)	11	(.5)	13	(.5)
Mixtures mainly grain	42	(1.8)	71	(3.0)	87	(4.3)
Total vegetables	205	(2.4)	187	(3.6)	189	(3.8)
Dark-green vegetables	10	(.7)	12	(.8)	14	(1.2)
Deep-yellow vegetables	10	(.3)	9	(.7)	10	(.9)
Tomatoes	27	(1.0)	25	(1.1)	28	(1.3)
Total fruits	142	(4.4)	150	(4.7)	156	(5.0)
Citrus juices	54	(2.6)	53	(2.7)	52	(2.9)
Bananas	8	(.4)	13	(.7)	17	(.8)
Noncitrus juices and nectars	12	(.8)	20	(2.2)	16	(1.7)
Total milk and milk products	203	(4.2)	206	(5.6)	202	(6.0)
Total fluid milk[3]	151	(3.5)	156	(5.1)	135	(4.2)
Whole milk	67	(4.3)	46	(2.9)	35	(2.9)
Lowfat milk	34	(1.2)	74	(4.2)	56	(3.5)
Skim milk	13	(.7)	34	(2.4)	41	(2.7)
Milk desserts	16	(.6)	18	(.9)	25	(1.8)
Cheese	16	(.7)	12	(.7)	15	(1.0)
Total meat, poultry, fish	184	(1.9)	167	(3.3)	168	(3.1)
Beef	47	(1.5)	22	(1.1)	19	(.9)
Pork	18	(.5)	10	(.5)	10	(.6)
Mixtures mainly meat, poultry, fish	60	(2.0)	78	(3.2)	85	(3.4)
Eggs	24	(.9)	16	(.9)	16	(.8)
Legumes	18	(1.4)	17	(1.3)	19	(1.2)
Nuts and seeds	2	(.2)	3	(.3)	3	(.3)
Total fats and oils	13	(.6)	16	(.5)	16	(.6)
Table fats	6	(.2)	5	(.2)	3	(.2)
Salad dressings	6	(.3)	9	(.5)	10	(.5)
Total sugars and sweets	17	(.6)	17	(.8)	19	(1.0)
Sugars	5	(.2)	4	(.2)	4	(.2)
Candy	2	(.2)	4	(.3)	5	(.5)
Total alcoholic beverages	32	(2.1)	40	(4.7)	59	(5.6)
Beer and ale	19	(1.7)	27	(4.2)	38	(4.6)
Total nonalcoholic beverages	698	(18.1)	753	(14.5)	854	(20.4)
Coffee	376	(14.5)	327	(13.0)	332	(13.9)
Total fruit drinks and ades	29	(2.1)	46	(2.7)	58	(4.4)
Total carbonated soft drinks	137	(4.0)	238	(7.6)	293	(13.3)
Regular carbonated soft drinks	101	(4.5)	140	(6.4)	178	(10.8)
Low-calorie carbonated soft drinks	34	(3.4)	97	(5.5)	115	(8.9)

[1]Because only selected food groups are included here, intakes from subgroups may not sum to totals.
[2]For descriptions of the foods included in the food groups named in this article, see "Table Notes" in reference 12.
[3]The proportion of total fluid milk intake that could be classified as whole, lowfat, or skim on the basis of information obtained from respondents was much higher in 1994-95 (nearly 98 percent) than in 1977-78 (75 percent or less).

Table 2. Mean percentages of individuals using items from selected food groups and standard errors of the percentage, women 20 years and over, 1 day, NFCS 1977-78, CSFII 1989-91, and CSFII 1994-95

Food group[1]	1977-78		1989-91		1994-95	
	Mean	(SEP)	Mean	(SEP)	Mean	(SEP)
			Percent			
Total grain products	94.8	(0.24)	96.3	(0.34)	96.8	(0.30)
Yeast breads and rolls	76.4	(.46)	69.6	(1.00)	66.9	(.81)
Cereals and pasta	35.6	(.52)	41.3	(1.11)	43.8	(1.01)
Ready-to-eat cereals	18.4	(.41)	23.3	(.70)	24.0	(.86)
Mixtures mainly grain	16.8	(.41)	26.6	(.88)	31.2	(1.08)
Total vegetables	86.3	(.37)	82.7	(.73)	84.0	(.79)
Dark-green vegetables	7.8	(.29)	11.4	(.68)	12.4	(.74)
Deep-yellow vegetables	10.2	(.33)	11.1	(.64)	15.3	(.84)
Tomatoes	25.5	(.47)	30.5	(.78)	39.0	(1.11)
Total fruits	54.2	(.54)	54.5	(1.18)	54.8	(1.12)
Citrus juices	26.7	(.48)	22.2	(.98)	20.8	(.87)
Bananas	7.1	(.27)	12.1	(.67)	14.9	(.64)
Noncitrus juices and nectars	4.9	(.24)	6.7	(.56)	5.1	(.45)
Total milk and milk products	77.1	(.45)	76.3	(.88)	77.1	(.87)
Total fluid milk[2]	59.1	(.53)	57.1	(1.11)	51.8	(1.16)
Whole milk	25.2	(.47)	19.6	(.85)	14.7	(1.23)
Lowfat milk	12.2	(.35)	26.3	(1.04)	22.8	(.90)
Skim milk	5.2	(.24)	11.8	(.65)	14.4	(.81)
Milk desserts	13.1	(.36)	13.1	(.60)	17.0	(.83)
Cheese	26.4	(.48)	27.1	(1.03)	32.1	(1.08)
Total meat, poultry, fish	92.1	(.29)	88.0	(.67)	85.3	(.70)
Beef	33.4	(.51)	20.5	(.87)	19.4	(.74)
Pork	25.1	(.46)	15.8	(.65)	16.6	(.79)
Mixtures mainly meat, poultry, fish	27.7	(.48)	32.7	(1.18)	34.0	(1.23)
Eggs	30.9	(.50)	19.2	(.76)	18.5	(.74)
Legumes	10.6	(.33)	11.3	(.58)	14.1	(.62)
Nuts and seeds	7.2	(.28)	8.5	(.51)	8.2	(.49)
Total fats and oils	63.2	(.52)	64.4	(.79)	60.9	(1.21)
Table fats	45.4	(.54)	40.2	(1.02)	33.6	(1.09)
Salad dressings	27.9	(.49)	32.8	(.89)	32.1	(1.21)
Total sugars and sweets	53.0	(.54)	51.4	(1.12)	56.8	(.95)
Sugars	38.5	(.52)	34.8	(1.03)	36.1	(.83)
Candy	4.6	(.23)	9.3	(.65)	12.2	(.74)
Total alcoholic beverages	9.7	(.33)	10.1	(.88)	11.8	(.91)
Beer and ale	3.2	(.19)	4.0	(.48)	4.3	(.38)
Total nonalcoholic beverages	91.8	(.30)	89.1	(.85)	90.7	(.54)
Coffee	66.9	(.51)	55.5	(1.31)	54.2	(1.17)
Total fruit drinks and ades	8.8	(.30)	12.2	(.65)	13.1	(.58)
Total carbonated soft drinks	32.2	(.50)	44.3	(1.07)	48.7	(1.32)
Regular carbonated soft drinks	24.5	(.48)	28.2	(.97)	31.7	(1.24)
Low-calorie carbonated soft drinks	8.1	(.30)	18.2	(.78)	18.5	(.93)

[1]For descriptions of the foods included in the food groups named in this article, see "Table Notes" in reference 12.
[2]The proportion of total fluid milk intake that could be classified as whole, lowfat, or skim on the basis of information obtained from respondents was much higher in 1994-95 (nearly 98 percent) than in 1977-78 (75 percent or less).

Table 3. Mean intakes per individual from selected[1] food groups and standard errors of the mean, men 20 years and over, 1 day, NFCS 1977-78, CSFII 1989-91, and CSFII 1994-95

Food group[2]	1977-78		1989-91		1994-95	
	Mean	(SEM)	Mean	(SEM)	Mean	(SEM)
			Grams			
Total grain products	252	(4.3)	324	(7.5)	361	(9.7)
Yeast breads and rolls	75	(1.0)	61	(1.3)	63	(2.0)
Cereals and pasta	52	(3.6)	87	(4.6)	89	(4.5)
Ready-to-eat cereals	9	(.3)	14	(.8)	16	(.8)
Mixtures mainly grain	56	(3.1)	104	(5.1)	128	(6.7)
Total vegetables	251	(5.5)	222	(4.5)	242	(4.4)
Dark-green vegetables	10	(1.0)	13	(1.3)	14	(1.4)
Deep-yellow vegetables	10	(.4)	10	(.8)	8	(.6)
Tomatoes	30	(.9)	31	(1.4)	37	(2.0)
Total fruits	142	(4.6)	150	(6.4)	172	(5.8)
Citrus juices	51	(2.8)	59	(4.2)	65	(4.6)
Bananas	10	(.7)	11	(.7)	19	(1.0)
Noncitrus juices and nectars	11	(1.0)	16	(1.9)	19	(2.4)
Total milk and milk products	276	(6.5)	254	(9.6)	256	(9.7)
Total fluid milk[3]	214	(6.4)	193	(8.1)	178	(6.6)
Whole milk	102	(5.8)	66	(5.2)	54	(3.8)
Lowfat milk	45	(2.1)	92	(5.5)	85	(5.6)
Skim milk	10	(1.0)	32	(3.8)	35	(3.6)
Milk desserts	23	(1.2)	24	(2.0)	33	(2.4)
Cheese	17	(.6)	16	(.9)	18	(0.9)
Total meat, poultry, fish	280	(2.7)	260	(5.4)	275	(5.3)
Beef	72	(2.4)	36	(1.9)	38	(2.4)
Pork	28	(.8)	15	(1.2)	15	(1.0)
Mixtures mainly meat, poultry, fish	92	(3.7)	124	(5.4)	137	(5.0)
Eggs	38	(1.0)	26	(1.5)	23	(1.1)
Legumes	26	(1.5)	30	(2.7)	31	(3.0)
Nuts and seeds	4	(.3)	4	(.4)	4	(.4)
Total fats and oils	17	(.8)	18	(.8)	18	(.9)
Table fats	8	(.4)	7	(.4)	5	(.4)
Salad dressings	7	(.4)	10	(.5)	11	(.6)
Total sugars and sweets	24	(1.0)	19	(1.1)	24	(1.4)
Sugars	6	(.2)	6	(.4)	4	(.3)
Candy	2	(.3)	3	(.4)	6	(.5)
Total alcoholic beverages	138	(8.4)	162	(10.3)	238	(23.6)
Beer and ale	121	(8.0)	145	(10.2)	216	(22.9)
Total nonalcoholic beverages	752	(12.9)	900	(21.8)	1,066	(21.7)
Coffee	421	(13.0)	408	(15.6)	408	(13.4)
Total fruit drinks and ades	35	(2.3)	60	(5.1)	86	(6.5)
Total carbonated soft drinks	154	(5.6)	292	(12.3)	404	(16.1)
Regular carbonated soft drinks	136	(6.5)	212	(10.4)	312	(15.8)
Low-calorie carbonated soft drinks	15	(1.5)	79	(6.2)	92	(6.8)

[1]Because only selected food groups are included here, intakes from subgroups may not sum to totals.
[2]For descriptions of the foods included in the food groups named in this article, see "Table Notes" in reference 12.
[3]The proportion of total fluid milk intake that could be classified as whole, lowfat, or skim on the basis of information obtained from respondents was much higher in 1994-95 (nearly 98 percent) than in 1977-78 (75 percent or less).

Table 4. Mean percentages of individuals using items from selected food groups and standard errors of the percentage, men 20 years and over, 1 day, NFCS 1977-78, CSFII 1989-91, and CSFII 1994-95

Food group[1]	1977-78		1989-91		1994-95	
	Mean	(SEP)	Mean	(SEP)	Mean	(SEP)
			Percent			
Total grain products	96.9	(0.22)	95.8	(0.47)	96.8	(0.37)
Yeast breads and rolls	82.5	(.49)	71.3	(.86)	69.0	(1.17)
Cereals and pasta	36.5	(.62)	40.5	(1.27)	40.8	(1.23)
Ready-to-eat cereals	19.7	(.51)	21.7	(.98)	22.0	(.87)
Mixtures mainly grain	16.9	(.48)	28.7	(1.14)	32.9	(1.19)
Total vegetables	87.9	(.42)	82.9	(.79)	86.1	(.71)
Dark-green vegetables	7.2	(.34)	10.6	(.82)	10.7	(.74)
Deep-yellow vegetables	8.7	(.37)	10.1	(.69)	12.2	(.75)
Tomatoes	25.8	(.57)	32.6	(1.20)	41.7	(1.09)
Total fruits	51.0	(.64)	47.8	(1.37)	49.9	(.99)
Citrus juices	23.9	(.56)	21.1	(1.03)	19.8	(1.15)
Bananas	8.4	(.37)	10.4	(.71)	14.8	(.72)
Noncitrus juices and nectars	4.4	(.27)	4.9	(.48)	5.0	(.46)
Total milk and milk products	78.0	(.53)	74.7	(1.17)	74.7	(1.31)
Total fluid milk[2]	61.6	(.63)	54.8	(1.32)	49.4	(1.30)
Whole milk	28.4	(.58)	21.3	(1.20)	15.0	(.87)
Lowfat milk	12.1	(.42)	25.4	(1.22)	24.5	(1.26)
Skim milk	3.0	(.22)	8.6	(.79)	9.7	(.68)
Milk desserts	15.5	(.47)	13.7	(.87)	18.3	(.88)
Cheese	26.0	(.57)	27.1	(1.10)	32.1	(1.10)
Total meat, poultry, fish	95.8	(.26)	91.7	(.51)	90.6	(.69)
Beef	38.8	(.63)	25.1	(1.19)	24.9	(.99)
Pork	31.0	(.59)	19.6	(.88)	17.9	(.83)
Mixtures mainly meat, poultry, fish	31.4	(.60)	38.5	(1.08)	40.1	(1.07)
Eggs	39.1	(.63)	24.1	(.89)	21.2	(.80)
Legumes	11.7	(.41)	13.4	(.82)	14.0	(.76)
Nuts and seeds	8.3	(.36)	8.6	(.61)	8.7	(.49)
Total fats and oils	63.5	(.62)	64.0	(1.12)	58.0	(1.18)
Table fats	48.6	(.64)	40.3	(1.18)	32.4	(1.08)
Salad dressings	27.1	(.57)	31.9	(1.16)	31.3	(1.08)
Total sugars and sweets	57.4	(.64)	49.7	(1.20)	52.2	(1.14)
Sugars	42.0	(.64)	33.9	(1.22)	33.4	(.99)
Candy	4.1	(.26)	7.1	(.61)	12.5	(.64)
Total alcoholic beverages	19.0	(.51)	21.6	(1.15)	23.7	(.96)
Beer and ale	12.8	(.43)	15.2	(.83)	17.9	(.78)
Total nonalcoholic beverages	90.4	(.38)	89.6	(.88)	92.2	(.52)
Coffee	67.7	(.60)	59.1	(1.30)	56.2	(1.03)
Total fruit drinks and ades	8.1	(.36)	11.5	(.78)	14.7	(.79)
Total carbonated soft drinks	31.3	(.59)	47.0	(1.33)	54.4	(1.30)
Regular carbonated soft drinks	27.7	(.59)	35.0	(1.16)	42.6	(1.53)
Low-calorie carbonated soft drinks	3.3	(.23)	13.2	(.71)	13.4	(.73)

[1]For descriptions of the foods included in the food groups named in this article, see "Table Notes" in reference 12.
[2]The proportion of total fluid milk intake that could be classified as whole, lowfat, or skim on the basis of information obtained from respondents was much higher in 1994-95 (nearly 98 percent) than in 1977-78 (75 percent or less).

Sample sizes for adults age 20 years and over were the following: 10,035 women and 7,027 men in the NFCS 1977-78; 6,229 women and 4,219 men in the CSFII 1989-91; and 3,284 women and 3,352 men in the CSFII 1994-95. Overall analytic Day-1 response rates were 56.9 percent in the NFCS 1977-78, 57.6 percent in the CSFII 1989-91, and 80 percent in the CSFII 1994-95.

Mean intakes are presented "per individual," meaning they include intakes by both consumers and nonconsumers of the food group. To calculate "per user" intakes, divide the mean intake by the percentage of individuals using the food expressed as a decimal. Since only selected subgroups are presented, subgroup intakes will not sum to the food group total.

For this article, a "trend" was defined very narrowly. For a given food group, a trend is claimed to exist only when mean intakes of the food (or percentages of individuals using the food) either rose or fell continuously from 1977-78 through 1989-91 to 1994-95. Further analysis with more complex methods may reveal additional trends.

Results and Discussion

Time Trends in Food Intakes

Grain products.—As shown in tables 1 to 5, adults 20 years and over in the United States ate more grain products,[1] especially grain mixtures (such as pizza and tacos), in 1994-95 than in 1977-78.

[1]For descriptions of the foods included in the food groups named in this article, see "Table Notes" in reference 12.

Table 5. Trends in food intakes, 1977-78 to 1994-95: Women and men 20 years and over, 1 day, NFCS 1977-78 and CSFII 1994-95

Food	Percent change in amounts consumed	
	Women	Men
Grain products	+44	+43
Mixtures	+107	+129
Fruit	+10	+21
Bananas	+112	+90
Fluid milk	-11	-17
Whole milk	-48	-47
Meat, poultry, and fish mixtures	+42	+49
Beverages	+25	+47
Beer and ale	+100	+79
Fruit drinks and ades	+100	+146
Soft drinks	+114	+162

Table 6. Food mixtures: Mean intakes and percentages of total weight by ingredient, adults 20 years and over, 1 day, 1994

Intakes and ingredients	Grain mixtures	Meat mixtures
	Grams	
Mean intakes	109	105
	Percent	
Ingredient:		
Grain products	32	14
Vegetables	24	28
Milk and milk products	8	6
Meat, poultry, and fish	8	34
Water	19	10
Other	9	8

Table 7. Vegetable intakes: Intakes of vegetables coded separately, intakes from grain mixtures and meat mixtures, and adjusted total intakes, adults 20 years and over, 1 day, CSFII 1989-91 and CSFII 1994

Intake source	Women		Men	
	1989-91	1994	1989-91	1994
	Grams			
Vegetables coded separately	187	190	222	242
From grain mixtures	16	22	25	30
From meat mixtures	22	25	35	33
Adjusted total vegetables	225	237	282	305

Vegetables.—No clear trend in vegetable intakes can be seen in this series of tables because of the widespread consumption of vegetables as part of grain mixtures and meat mixtures. This issue is explored further in the section called "Breaking Down Mixtures."

Fruits.—Overall, the average intake of fruit rose slightly, but the percentages of women and men eating fruit or drinking fruit juice[2] in a day remained about the same. In 1994-95, only 55 percent of women and 50 percent of men ate fruit or drank fruit juice in a day. Meanwhile, intakes of fruit drinks and ades[3] doubled for women and more than doubled for men between 1977-78 and 1994-95, partly due to increases in the percentages of individuals consuming those drinks. Percentages of individuals eating bananas also doubled for women and nearly doubled for men between 1977-78 and 1994-95.

[2]Fruit juices (includes citrus juices plus noncitrus juices and nectars) are 100 percent juice.

[3]Fruit drinks and ades contain less than 100 percent juice.

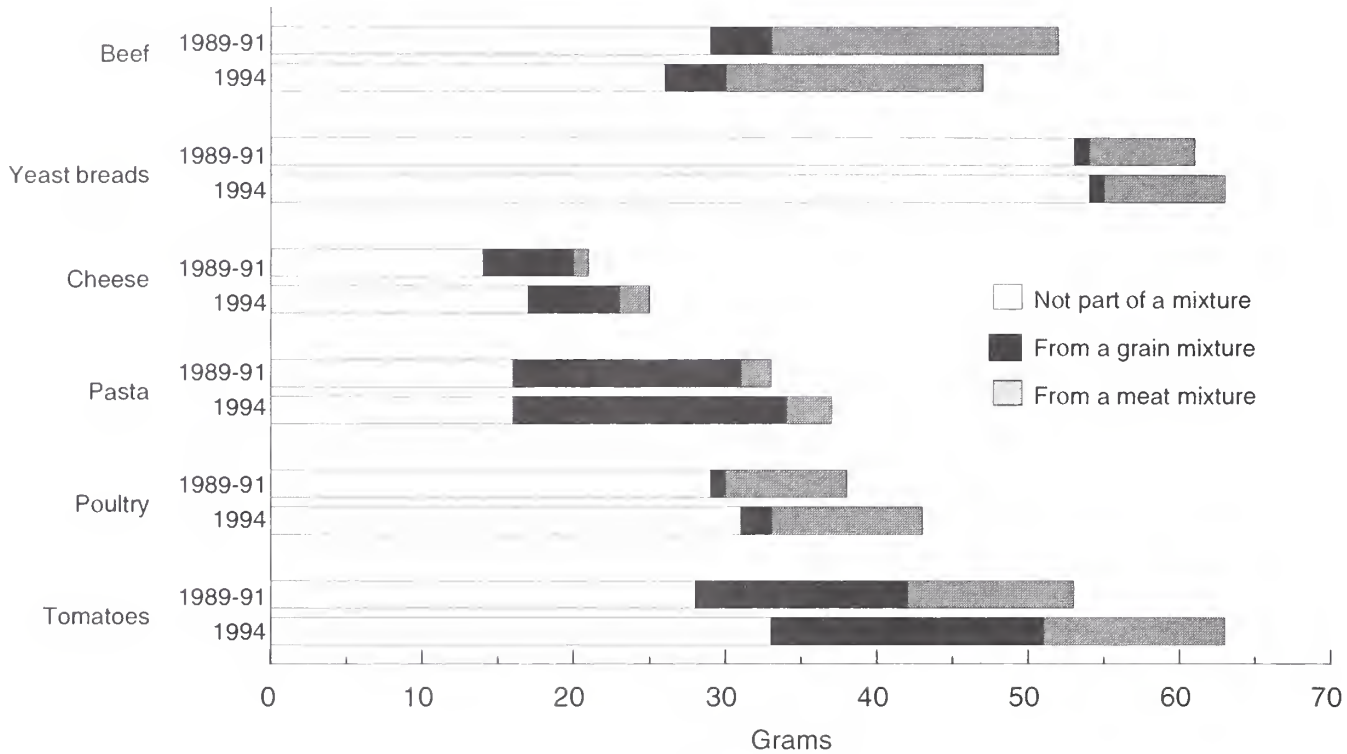
Milk and milk products.—The percentages of adults drinking whole milk declined progressively for both women and men, while the percentages drinking skim milk increased.

Meat, poultry, and fish.—In the meat, poultry, and fish group, the percentages of individuals eating separate cuts of beef and pork decreased. Higher percentages of women and men ate meat mixtures (such as stew or a hamburger on a bun), and they ate larger amounts.

Beverages.—Observed increases in intakes of beer and ale between 1977-78 and 1994-95 among both women and men may in part reflect a decrease in underreporting. This possibility is suggested because the trend seen here is not paralleled by per capita consumption trends for the same time period *(see 11)*. It has been noted that "sensitive items" for which "public awareness is heightened" are subject to bias in self-reporting *(12)*. Perhaps the level of sensitivity associated with reporting beer intakes has decreased. Another

...since 1989-91, amounts of soft drinks consumed by both women and men have surpassed their intakes of milk.

Figure 1. Ingredients from breakdown of grain mixtures and meat mixtures added to foods coded separately, selected food groups, adults 20 years and over, 1 day



Source: U.S. Department of Agriculture, Agricultural Research Service, Beltsville Human Nutrition Research Center, Food Surveys Research Group. USDA Continuing Survey of Food Intakes by Individuals 1989-91 and 1994.

reason for increased intakes of beer and ale, as well as other foods, may be improved quality of the data collected using the multiple-pass approach (see "Design and Methods" above).

Both the percentages of adults 20 years and over drinking carbonated soft drinks and mean intakes of soft drinks increased progressively and substantially between 1977-78 and 1994-95. In fact, since 1989-91, amounts of soft drinks consumed by both women and men have surpassed their intakes of milk. In 1994-95, a higher percentage of men drank soft drinks than drank milk. In 1994-95, men's mean intake of beer exceeded their intake of fluid milk, although it was lower than their intakes of coffee and soft drinks.

Breaking Down Mixtures

When CSFII food intake tables such as tables 1 to 5 are created, a food mixture that was reported and coded as a single item is classified under the food group of its major ingredient. For this reason, secondary ingredients may be included under food groups other than the ones they would appear in if each ingredient were reported and coded separately. For example, cheese pizza is a mixture of dough, tomato sauce, and cheese. Pizza's major ingredient is dough, so pizza is classified under grain products in the subgroup "grain mixtures." Thus, the secondary ingredients in the pizza (cheese and tomato sauce) are included in the grain category rather than under milk and milk products (cheese) and vegetables (tomatoes).

Table 8. Nutrient intakes as percentages of 1989 Recommended Dietary Allowances (RDA): Selected mean intakes per day and standard errors of the mean, adults 20 years and over, 1 day, CSFII 1994-95

Nutrient	Percentage of RDA			
	Women		Men	
	Mean	(SEM)	Mean	(SEM)
	Percent			
Protein	127	(1.2)	154	(2.2)
Vitamin A[1]	118	(3.3)	116	(4.7)
Vitamin B_6	94	(1.0)	110	(1.8)
Vitamin B_{12}	212	(7.7)	335	(25.7)
Folate	122	(1.8)	150	(2.5)
Vitamin C	147	(3.2)	186	(4.2)
Vitamin E	88	(1.9)	100	(2.3)
Calcium	77	(1.1)	107	(2.2)
Iron	100	(1.0)	185	(3.6)
Magnesium	83	(.9)	94	(1.5)
Zinc	76	(.9)	94	(1.9)
Food energy	78	(.7)	91	(1.3)

[1]The unit of vitamin A intake used in this calculation was µg RE.

This method of categorizing mixtures gives a good picture of what types of dishes people eat, but it can mask what is happening with intakes of foods that are widely used as ingredients in mixtures. Because of the increasing popularity of mixtures, the ability to look at foods that are ingredients in mixtures can make an important contribution to understanding trends in food intakes. For this reason, the grain mixtures and meat mixtures food groups were broken down into their ingredients to provide the information shown in tables 6 and 7 and figure 1. Predictably, the predominant ingredient (by weight) of grain mixtures is grain products, and the predominant ingredient of meat mixtures is meat, poultry, and fish (table 6).

Vegetables are the second largest ingredient of both grain mixtures and meat mixtures. Illustrated in figure 1 are the intakes of several foods that are often ingredients in mixtures; for each food, the corresponding bar represents the intake from food coded separately plus the intakes from grain mixtures and meat mixtures. In both 1989-91 and 1994,[4] intake of pasta was doubled when mixtures were broken down, and intakes of beef and tomatoes were nearly doubled.

As mentioned in the preceding section, no clear trend in vegetable intakes was apparent from tables 1 to 4. However, as shown in table 7, when vegetable intakes are adjusted by adding the amount from mixtures to the intake of vegetables coded separately, small increases over time can be seen in vegetable intakes for both women and men.

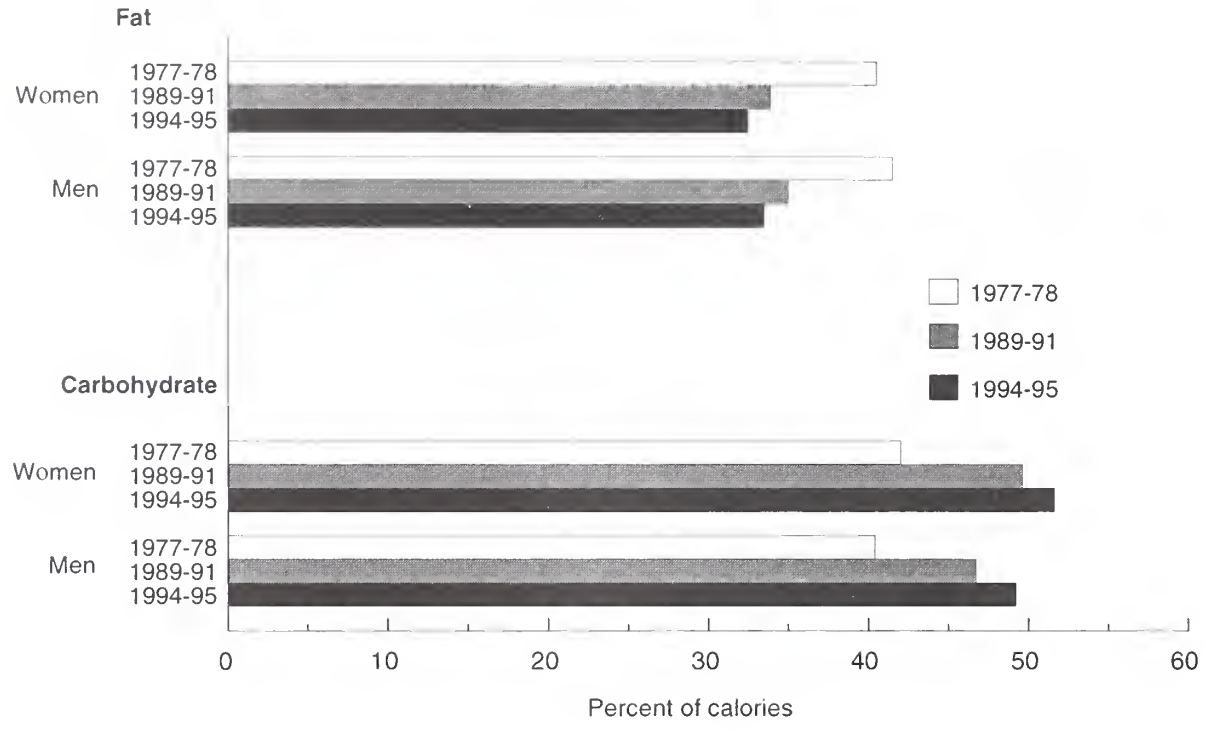
Energy, Nutrients, and Other Food Components

Energy.—In 1994-95, mean food energy intakes were estimated to be 1,633 kcal for women and 2,470 kcal for men *(21)*. This level of energy intake represents 78 percent of the RDA *(8)* for women and 91 percent for men (table 8). In apparent contradiction to this finding, 31 percent of women and 32 percent of men in the CSFII 1994-95 were overweight,[5] according to body mass index estimates from self-reported height and weight data *(21)*. A similar percentage of overweight men and a slightly higher percentage of overweight women were found in the National Health and Nutrition Examination Survey (NHANES) 1988-94 *(9)*.

[4]Mixtures breakdown data from the CSFII 1995 were not available as this article was being written.

[5]Overweight is defined as body mass index (kg/m^2) ≥27.3 for women and ≥27.8 for men (85th percentiles from NHANES II for ages 20 to 29 years).

Figure 2. Food energy intake from fat and carbohydrate, adults 20 years and over, 1 day



Source: U.S. Department of Agriculture, Agricultural Research Service, Beltsville Human Nutrition Research Center, Food Surveys Research Group. USDA Nationwide Food Consumption Survey 1977-78 and USDA Continuing Survey of Food Intakes by Individuals 1989-91 and 1994-95.

Underreporting and sedentary lifestyles are two factors that may help to explain the disparity between energy intake estimates and prevalence of overweight. It is widely recognized that some individuals in nutrition studies underreport the food they eat *(1, 7, 12)*. Also, the average energy allowances are designed for a light-to-moderate level of physical activity. The actual level of physical activity of many individuals in the United States is lower than light-to-moderate. In the CSFII 1994-95, in answer to the question, "How often do you exercise vigorously enough to work up a sweat?", 44 percent of women and 28 percent of men answered "rarely" or "never" *(21)*. In 1996, the Surgeon General concluded that 60 percent of American adults are not regularly active and 25 percent are not active at all *(20)*, based on data from 1985 through 1994.

Energy-providing nutrients.—For both women and men, the proportion of food energy intake provided by protein was 16 to 17 percent of calories in all three survey periods. In contrast, the proportion of energy from fat decreased between 1977-78 and 1994-95, and the proportion of energy from carbohydrate increased as discussed below. In 1994-95, the proportion of energy from alcohol was 1 percent of calories for women and 3 percent of calories for men.

For women, the proportion of energy from fat fell from 40 percent of calories in 1977-78 to 32 percent in 1994-95, and the proportion of energy from carbohydrate climbed from 42 to 52 percent of calories (fig. 2). Likewise for men, the proportion of energy from fat dropped from 42 to 34 percent of calories, and the proportion of energy from carbohydrate rose from 40 to 49 percent of calories. The shift to lower fat intakes has been paralleled by a decrease in the average serum total cholesterol level of individuals age 20 through 74 years in the United States from 213 mg/dL in 1976-80 to 205 mg/dL in 1988-91 *(6)*.

In 1994-95, average fat intakes as a percentage of calories by both women and men still exceeded the Dietary Guidelines recommendation of 30 percent of calories or less, and saturated fat intakes (11 percent of calories for both women and men) still exceeded the recommendation of less than 10 percent of calories *(19)*.

When CSFII 1994 food intakes were compared with the Food Guide Pyramid *(18)*, discretionary fat[6] intake accounted for 25 percent of calories for both women and men 20 years and over *(2)*. Although the Pyramid does not mention a specific percentage of calories from discretionary fat, 25 percent is most likely much too high. Individuals will get up to half of the recommended 30 percent of calories from fat if they eat the recommended number of servings from each Pyramid food group, choose the lowest fat choices within each food group, and add no fat to foods in preparation or at the table *(18)*. Any additional fat—that is, discretionary fat—should be low enough to keep the total fat at 30 percent or less of calories.

[6]Discretionary fat was defined as fat added to foods in preparation or at the table and as excess fat above amounts people would consume if they selected only the lowest fat foods within the major food groups. Examples cited were the fat absorbed by french-fried potatoes during preparation, the fat from margarine spread on bread at the table, and the fat in whole milk.

In 1994, sugar intake was also higher than the Food Guide Pyramid recommends. Women consumed almost 15 teaspoons of added sugars[7] in a diet providing 1,587 calories, and men consumed 21 teaspoons of added sugars at an energy intake of 2,403 calories *(2)*. The Pyramid suggests that Americans try to limit their added sugars to 6 teaspoons a day if they eat about 1,600 calories, 12 teaspoons at 2,200 calories, or 18 teaspoons at 2,800 calories.

Vitamins and minerals.—As shown in table 8, mean nutrient intakes[8] by both women and men age 20 years and over met or exceeded the RDA for protein, vitamins A, B_{12}, and C, folate, and iron. (However, women age 20 to 49 years had mean iron intakes below the RDA.) Mean intakes by men (but not women) also met or exceeded the RDA for vitamins B_6 and E and calcium. Neither women nor men had intakes that met the RDA for magnesium or zinc. In general, the nutrients that were below the RDA in 1994-95 are the same nutrients that were below the RDA in 1977-78. (Vitamin E and zinc were not examined in 1977-78.)

[7]The definition of added sugars included white sugar, brown sugar, raw sugar, corn syrup, honey, molasses, and artificial sweeteners containing carbohydrate that were eaten separately or used as ingredients in processed or prepared foods such as breads, cakes, soft drinks, jams, and ice cream; it did not include sugars such as fructose and lactose that occur naturally in foods such as fruit and milk. Quantities were standardized on a carbohydrate equivalent basis. One teaspoon of added sugars was defined as the quantity of a sweetener that contains the same amount of carbohydrate as 1 teaspoon (4 grams) of table sugar (sucrose).

[8]Nutrient intake estimates in table 8 are based on intakes from food and do not include intakes from supplements.

Other food components.—Between 1989-91 and 1994-95,[9] cholesterol intakes decreased slightly among both women and men, and dietary fiber intakes increased somewhat *(14, 21)*. The 1994-95 mean cholesterol intake by women (217 mg) met the recommendation to consume less than 300 mg per day, but the average cholesterol intake by men (337 mg) still exceeded the recommendation *(19)*. Mean dietary fiber intakes in 1994-95 were 13.7 g for women and 18.5 g for men, in contrast with the 1989-91 estimates of 12.3 g and 16.7 g, respectively. Many expert groups recommend increasing fiber intakes by increasing intakes of vegetables, fruits, and whole grain products without specifying a fiber goal in grams; other groups have proposed increasing fiber intakes to 20 to 35 g per day *(4, 10)*.

[9]Cholesterol and fiber intake data are not available from the NFCS 1977-78.

Summary and Recommendations

Adults in the United States ate somewhat differently in 1994-95 than their counterparts did two decades before, with mixed results. Adults' low intakes of fiber, magnesium, and zinc could be improved by increasing intakes of whole grains, fruits, dark green vegetables, legumes, and lean meats and meat alternates as recommended by the Food Guide Pyramid *(18)*. The proportion of milk intake that was skim milk increased, but milk intakes overall declined. Women's low calcium intakes could be boosted by increasing intakes of skim and lowfat dairy products.

The proportion of energy from fat was lower and that from carbohydrate higher in 1994-95 than in 1977-78. This shift was consistent with other national data showing a decrease in the average blood cholesterol level among adults. On the other hand, more adults were overweight in 1994-95 than before. Adults' diets would benefit overall by decreasing intakes of foods and beverages that are high in fats and sugars but provide few other nutrients. In addition, when choosing among more nutrient-dense foods, adults would do well to shift toward items lower in fat and sugar.

Low activity levels probably contributed to the high percentage of adults who were overweight in 1994-95. For better health, adults should become more active.

Acknowledgments

The authors wish to thank Katherine E. Sykes for her review of the manuscript and helpful comments.

References

1. Bingham, S.A. 1987. The dietary assessment of individuals: Methods, accuracy, new techniques and recommendations. *Nutrition Abstracts and Reviews* 57*(10)*:705-742.

2. Cleveland, L.E., Cook, A.J., Wilson, J.W., Friday, J.E., Ho, J.W., and Chahil, P.S. 1997, March 10. *Pyramid Servings Data: Results from USDA's 1994 Continuing Survey of Food Intakes by Individuals*, [Online]. ARS Food Surveys Research Group. Available (under "Releases"): <http://www.barc.usda.gov/bhnrc/foodsurvey/home.htm>[visited 1997, September 2].

3. DeMaio, T.M., Ciochetto, S., and Davis, W.L. 1993. Research on the Continuing Survey of Food Intakes by Individuals. In: *1993 Proceedings of the Section on Survey Research Methods, papers presented at American Statistical Association, San Francisco, August 8-12, 1993, and American Association for Public Opinion Research, St. Charles, IL, May 20-23, 1993, vol. II,* pp. 1021-1026. American Statistical Association, Alexandria, VA.

4. Federation of American Societies for Experimental Biology, Life Sciences Research Office. 1987. *Physiological Effects and Health Consequences of Dietary Fiber.* Bethesda, MD.

5. Guenther, P.M., DeMaio, T.J., Ingwersen, L.A., and Berlin, M. 1996. The multiple-pass approach for the 24-hour recall in the Continuing Survey of Food Intakes by Individuals (CSFII) 1994-96. *The FASEB Journal* 10*(3)*:A198.

6. Johnson, C.L., Rifkind, B.M., Sempos, C.T., Carroll, M.D., Bachorik, P.S., Briefel, R.R., Gordon, D.J., Burt, V.L., Brown, C.D., Lippel, K., and Cleeman, J.I. 1993. Declining serum total cholesterol levels among US adults: The National Health and Nutrition Examination Surveys. *Journal of the American Medical Association* 269:3002-3008.

7. Mertz, W., Tsui, J.C., Judd, J.T., Reiser, S., Hallfrisch, J., Morris, E.R., Steele, P.D., and Lashley, E. 1991. What are people really eating? The relation between energy intake derived from estimated diet records and intake determined to maintain body weight. *American Journal of Clinical Nutrition* 54:291-295.

8. National Academy of Sciences, National Research Council, Food and Nutrition Board. 1989. *Recommended Dietary Allowances* (10th ed.). National Academy Press, Washington, DC.

9. National Center for Health Statistics and Centers for Disease Control and Prevention. 1997. Update: Prevalence of overweight among children, adolescents, and adults—United States, 1988-1994. *Morbidity and Mortality Weekly Review* 46*(9)*:199-202.

10. National Institutes of Health, National Cancer Institute. 1987. *Diet, Nutrition, and Cancer Prevention: A Guide to Food Choices.* NIH Publ. No. 87-2878.

11. Putnam, J.J. and Allshouse, J.E. 1993. *Food Consumption, Prices, and Expenditures, 1970-92.* U.S. Department of Agriculture, Economic Research Service, Statistical Bulletin No. 867 (table 36).

12. Schoeller, D.A. 1990. How accurate is self-reported dietary energy intake? *Nutrition Reviews* 48*(10)*:373-379.

13. Tippett, K.S. and Cypel, Y.S. (Eds.). 1997. *Design and Operation: The Continuing Survey of Food Intakes by Individuals and the Diet and Health Knowledge Survey 1994-96.* Continuing Survey of Food Intakes by Individuals 1994-96, Nationwide Food Surveys Rep. No. 96-1. U.S. Department of Agriculture, Agricultural Research Service.

14. Tippett, K.S., Mickle, S.J., Goldman, J.D., Sykes, K.E., Cook, D.A., Sebastian, R.S., Wilson, J.W., and Smith, J. 1995. *Food and Nutrient Intakes by Individuals in the United States, 1 Day, 1989-91.* Continuing Survey of Food Intakes by Individuals 1989-91, Nationwide Food Surveys Rep. No. 91-2. U.S. Department of Agriculture, Agricultural Research Service.

15. U.S. Department of Agriculture, Human Nutrition Information Service. 1983. *Food Intakes: Individuals in 48 States, Year 1977-78.* Nationwide Food Consumption Survey 1977-78, Rep. I-1. National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; (703) 487-4650. Technical report: Accession no. PB91-103523INZ.

16. U.S. Department of Agriculture. 1995. *CSFII/DHKS 1994 Data Set and Documentation: The 1994 Continuing Survey of Food Intakes by Individuals and the 1994 Diet and Health Knowledge Survey.* National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; (703) 487-4650. Computer tape: Accession no. PB96-500095. CD-ROM: Accession no. PB96-501010.

17. U.S. Department of Agriculture. 1996. *CSFII/DHKS 1995 Data Set and Documentation: The 1995 Continuing Survey of Food Intakes by Individuals and the 1995 Diet and Health Knowledge Survey.* National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; (703) 487-4650. Computer tape: Accession no. PB97-500771. CD-ROM: Accession no. PB97-500789.

18. U.S. Department of Agriculture, Center for Nutrition Policy and Promotion. 1996. *The Food Guide Pyramid.* Home and Garden Bulletin No. 252, sl. rev.

19. U.S. Department of Agriculture and U.S. Department of Health and Human Services. 1995. *Nutrition and Your Health: Dietary Guidelines for Americans* (4th ed.). Home and Garden Bulletin No. 232.

20. U.S. Department of Health and Human Services, Centers for Disease Control and Prevention. 1997. *Physical Activity and Health: A Report of the Surgeon General.* Atlanta, GA.

21. Wilson, J.W., Enns, C.W., Goldman, J.D., Tippett, K.S., Mickle, S.J., Cleveland, L.E., and Chahil, P.S. 1997, April 18. *Data Tables: Combined Results From USDA's 1994 and 1995 Continuing Survey of Food Intakes by Individuals and 1994 and 1995 Diet and Health Knowledge Survey,* [Online]. ARS Food Surveys Research Group. Available (under "Releases"): <http://www.barc.usda.gov/bhnrc/foodsurvey/home.htm>[visited 1997, September 2].

Trends in Marketing and Usage of Fat-Modified Foods: Implications for Dietary Status and Nutrition Promotion

Nancy E. Schwenk
Joanne F. Guthrie

Center for Nutrition Policy and Promotion

The tremendous increase in the number of fat-modified foods is one of the most notable changes in the retail food market that has occurred in the past few years. These products have the potential to change Americans' eating habits and could have significant effects on dietary status. The purposes of this article are to inform nutrition and consumer educators of this trend and the factors that have contributed to it; to examine concerns that have been raised in relation to this trend; and to discuss the potential implications for nutrition promotion.

In recent years, there has been an enormous increase in the number of fat-modified foods in the marketplace. This increase has been spurred by consumer interest and further fueled by passage of the Nutrition Labeling and Education Act (NLEA). The rapid influx of fat-modified food products into the marketplace has raised concerns regarding their use, including potential physiological effects, price, and potential impact on overall diet quality.

This paper will define fat-modified foods, discuss the factors that have led to their increased presence in the marketplace, and review the evidence on the concerns raised. It will identify future research issues and discuss the challenges for nutrition education and promotion in helping consumers understand the role of fat-modified foods in their diets.

Definition of Fat-Modified Foods

Some fat-modified foods can be created merely by removing fat from a conventional food product—skim milk is a good example of this type of modification. For many foods, however, fat provides important sensory and functional qualities, and simply removing it would not result in an acceptable product. In those foods, fat substitutes are used to mimic the qualities provided by fat, such as the rich, creamy "mouth feel" of ice cream or the moist texture of a cake (table 1). In this paper, the term "fat-modified foods" will be used to refer to all food products in which the fat content has been reduced compared with a standard product, either by simply removing fat or by replacing fat wholly or partially with some type of fat substitute.

In some products, fat can be replaced or reduced using relatively simple techniques. For example, water can be added to some foods, like margarine, to dilute their fat concentration. Sometimes fat reduction can be accomplished by substituting familiar ingredients for fat in a product. Widely used examples would be fruit purees like prune paste or applesauce that are used in both homemade and commercially baked goods as substitutes for fat in a recipe.

In addition to these modifications, food technologists have developed or modified other compounds for use as fat substitutes. These fat substitutes can be based on protein, carbohydrate, or a reduced-calorie or noncaloric version of fats *(17)*. Table 2 provides examples of some of the major fat substitutes that fall into these categories.

Table 1. Functions of fat reduction ingredients

- Bulking agent
- Gelling
- Moisturizer
- Provide mouth feel
- Stabilizer
- Texturizer
- Thickener

Source: International Food Information Council Foundation, 1995, Uses and Nutritional Impact of Fat Reduction Ingredients, November issue.

Table 2. Types of fat substitutes[1]

Category	Examples
Protein-based	Simplesse
Carbohydrate-based	Dextrins and modified starches Polydextrose Cellulose Gums and pectin Oatrim and Z-trim
Reduced and noncaloric fat-based	Caprenin Salatrim Mono- and diglycerides Olestra *Under Development:* DDM EPG TATCA

[1] Adapted from International Food Information Council, 1995, Uses and Nutritional Impact of Fat Reduction Ingredients, November issue.

Protein-Based Fat Substitutes

Protein-based fat substitutes, such as Simplesse[1] (made by the NutraSweet Company) and similar products, are created by a process called microparticulation. Proteins are heated and blended at high speed, producing tiny, spherical particles that give foods a creamy "mouth feel" similar to that of fats *(3)*. They can be used in such products as reduced-fat ice cream and dairy desserts, mayonnaise, salad dressings, and cheese but cannot be used to make reduced-fat fried foods such as potato chips and french fries *(3)*. Protein provides 4 calories per gram and fat provides 9 calories per gram; these substitutes provide 1-4 calories per gram, depending on the amount of hydration of the product *(20)*. In addition, they may be usable in smaller amounts than the fats they replace; for example, 1 gram of Simplesse can be used to replace 3 grams of fat in ice cream *(17)*.

Carbohydrate-Based Fat Substitutes

There are a number of carbohydrate-based fat substitutes, and they are used in a wide range of food products such as salad dressings, baked products, cheeses, processed meats, sour cream, yogurt, and puddings *(20)*. Like protein-based fat substitutes, they cannot be used to fry foods *(3)*.

Among the most common carbohydrate-based fat substitutes are dextrins and modified starches. These compounds absorb water, forming gels that have a texture and mouth feel similar to fat. Gums such as guar gum are used as fat replacers, particularly in foods such as salad dressings where they also act as stabilizers. Pectin is another gel-forming carbohydrate sometimes used as a fat substitute.

Indigestible fiber cellulose can be ground into microparticles that can form gels that are used as fat substitutes *(3)*. Two new fiber-based fat substitutes are Oatrim and Z-trim, which were developed by scientists at USDA. Oatrim is produced from oat fiber *(3)*, whereas Z-trim is made from a mixture of plant fibers, including oat, corn, rice, wheat, and soybean fiber *(34)*.

Polydextrose, a glucose polymer used to replace sugar or fat in foods, helps keep foods such as lowfat cakes and desserts moist. It also acts as a bulking agent replacing volume lost by the removal of fat and/or sugar *(3)*.

Like proteins, carbohydrates provide 4 calories per gram. Carbohydrate-based fat substitutes can supply 0 to 4 calories per gram, depending on the specific ingredient and how it is used *(20)*. Dry forms of dextrins can supply 4 calories per gram; hydrated forms, 1-2 calories per gram; and gums and fibrous carbohydrates such as cellulose contribute virtually no calories *(20)*.

Reduced and Noncaloric Fat-Based Substitutes

Reduced and noncaloric fat-based substitutes can be used in chocolate, dairy products, and other foods. Some reduced-calorie and noncaloric fat-based substitutes can be used to fry foods *(17)*. The reduced-calorie fat-based substitutes Caprenin (Procter and Gamble Company) and Salatrim (Nabisco, Inc.) are only partially digested and absorbed and, therefore, contribute fewer calories per gram than conventional fats—5 calories per gram compared with 9 calories per gram *(17)*. Other fat-based substitutes have been created using mono- and diglycerides. Although mono- and diglycerides provide the same amount of calories as other fats, they can be used in smaller amounts, thus reducing total fat and calories *(17)*.

Olestra, a fat substitute recently approved by the Food and Drug Administration (FDA) for use in snack products, is not digested and absorbed at all and is, therefore, noncaloric. Despite its recent approval as a fat substitute, its use remains controversial (see box, pp. 21 and 22). Several potential noncaloric fat-based substitutes are currently under development. Among them are dialkyl dihexadecylmalonate (DDM), esterified propoxylated glycerol (EPG), and trialkoxytricarballate (TATCA) *(17)*.

Reasons for the Increase in Fat-Modified Foods

Health Concerns

Diseases resulting from poor diet or inadequate physical activity cause an estimated 300,000 deaths a year *(25)*. High fat intakes, in particular, are associated with an increased risk of coronary heart disease, stroke, certain types of cancer, hypertension, diabetes, and other diseases *(17)*. Researchers studying the effects of reduced dietary intake of saturated fat on the incidence and economic costs of coronary heart disease estimated that a 3-percent drop in saturated fat intake could prevent about 100,000 new cases of coronary heart disease by the year 2005 and save nearly $13 billion in medical costs and lost earnings (in 1993 dollars) *(28)*.

[1]Use of commercial or trade names does not imply approval or constitute endorsement by the U.S. Department of Agriculture (USDA).

The *1995 Dietary Guidelines for Americans*, issued jointly by the U.S. Departments of Agriculture and Health and Human Services as the official statement of Federal dietary guidance policy, recommend, for healthy persons age 2 and over,[2] limiting saturated fat to less than 10 percent of calories consumed and total fat intake to 30 percent or less. In addition, numerous health organizations such as the American Heart Association *(22)* and the American Cancer Society *(1)* recommend a lowfat diet—no more than 30 percent of total calories from fat.

Since fat supplies energy and essential fatty acids and aids absorption of fat-soluble vitamins A, D, E, and K, some fat is needed in the diet *(36)*. However, most Americans consume more dietary fat than what is considered to be a healthy amount. In 1995, Americans averaged 33 percent of their total caloric intake from fat *(35)*. Although this is a decline from the 1977-78 figure of approximately 41 percent of calories from fat *(40)*, it is still above recommendations.

Table 3. Leading changes in dietary behavior, 1992-96[1]

Dietary change	Year				
	1992	1993	1994	1995	1996
	Percent				
More fruits/vegetables	60	62	63	63	77
Less fats/oils	28	26	32	34	42
Less meat/red meat	31	30	31	34	32
Less sugar	12	15	13	15	20
Less snack foods/junk foods	12	12	11	12	18
Less salt/sodium	8	8	7	6	13
Eating more chicken/turkey/ white meat	14	14	13	16	12
Less fried foods	7	6	6	6	9
Eating more fish	10	10	8	8	8
Less dairy/butter/cheese/ whole milk	7	4	6	6	7
More fiber	8	8	7	5	7
More starch/rice/potato/pasta	5	5	7	8	6
Less cholesterol	8	6	3	3	6
More whole grain	2	3	1	6	4
More fresh foods	3	3	5	3	3

[1]Shoppers were asked, "What, if anything, are you eating more of to ensure that your diet is healthy? What, if anything, are you eating less of to ensure that your diet is healthy?" (Multiple responses accepted.)
Source: Food Marketing Institute, 1996, Trends in the United States: Consumer Attitudes and the Supermarket, 1996.

Consumer Reaction

The belief that food and nutrition have a strong impact on personal health is growing among consumers. The importance of nutrition as a determinant in food-buying decisions is at an all-time high (78 percent). In 1996, 97 percent of food shoppers claimed to have changed their eating habits to reflect a healthier diet, up from 92 percent the previous year *(30)*. The leading changes in dietary behavior reported in 1996 were an increase in fruits and vegetables and a decrease in fats and oils (table 3).

The most common motivation for making these changes was weight control, rather than concern about disease *(15)*.

Among food shoppers with nutritional concerns (an overwhelming 94 percent in 1996), fat is likely to be the main concern *(14)*. When asked their specific concerns about the nutritional content of food, these shoppers indicated that their top concerns were: Fat (60 percent), salt/sodium (28 percent), cholesterol (26 percent), sugar (12 percent), calories (12 percent), and vitamin/mineral content (12 percent) (multiple answers were accepted) (table 4, p. 22). Concern about fat peaked in 1995 at 65 percent *(14)*.

It can be difficult for a person to adopt a lowfat diet. It may require changing basic food selection and preparation patterns. Often, many culturally based or favorite foods must be limited *(3)*. In addition, many consumers (nearly half of food shoppers) are confused and unsure about how to modify fat intake. Substituting a fat-modified food for its regular counterpart may seem a simpler way to reduce fat than eating different types of foods.

[2]Fat intakes by children ages 2 to 5 should be gradually decreased to no more than 30 percent of calories from fat *(36)*.

In 1995, Americans averaged 33 percent of their total caloric intake from fat.

Olestra

In the past year, foods containing olestra, a noncaloric fat substitute manufactured by Procter & Gamble, have begun to appear on American supermarket shelves. Olestra, chemically referred to as sucrose polyester, is formed by joining sucrose with fatty acids obtained from vegetable oils *(17)*. Olestra is not broken down by digestive enzymes. It passes through the gastrointestinal tract without being digested and absorbed and therefore provides no calories.

Olestra tastes like fat and, unlike protein- and carbohydrate-based fat substitutes, it can be used in frying to make reduced-fat potato chips, french fries, and other fried foods. It can also be used as a fat substitute in baked goods, spreads, salad dressings, candy, ice cream, and other foods *(17)*.

Most fat substitutes currently used by food manufacturers are classified by the FDA as GRAS (generally recognized as safe). Olestra, as a novel ingredient, had to be approved by the FDA as a food additive. Procter & Gamble first petitioned FDA for approval of olestra as a food additive in 1987 *(18)*. Between 1987 and 1995, Procter & Gamble submitted to FDA results of more than 150 studies on olestra's physiological effects *(8)*.

Two major concerns about the safety of olestra have been raised: The first is olestra's effects on the absorption of some nutrients; the second is its gastrointestinal effects. Olestra has been found to impair the absorption of the fat-soluble vitamins A, D, E, and K. It also interferes with the absorption of carotenoids. Beta carotene is a precursor of vitamin A; some research suggests that other carotenoids may also have important health effects *(21)*. In addition, it has been suggested that olestra may interfere with the absorption of some potentially beneficial phytochemicals *(21)*.[1]

Olestra's gastrointestinal effects occur because it passes through the digestive tract unabsorbed. As originally formulated, consumption of olestra could result in anal leakage. Reformulation appears to have alleviated this problem, at least partially, but olestra consumption still may result in loose stools and gastrointestinal distress *(18)*.

The data presented by Procter & Gamble were reviewed by FDA's Center for Food Safety and Nutrition (CFSAN), Center for Veterinary Medicine, and Food Advisory Committee *(8)*. Most members of the Food Advisory Committee accepted olestra's safety, but a minority advised rejection of the petition *(32)*. There also was vocal public opposition to approval of olestra; opposing groups included the Center for Science in the Public Interest (CSPI), the American Public

[1]Phytochemicals are defined as non-nutrient, physiologically active components of plants *(21)*. Investigation of their potential health properties is an emerging area of research.

Health Association, the American Academy of Ophthalmology, and Consumers Union *(32)*. Nevertheless, in January 1996, FDA approved use of olestra as an additive in savory snacks, for example, potato chips and crackers. Olestra can be used to replace up to 100 percent of the conventional fat or oil used in one of these products, but for olestra to be used in other products, a new petition would have to be filed by Procter & Gamble and approved by FDA *(18)*.

As a condition of approval, FDA required olestra-containing foods to be fortified with vitamins A, D, E, and K. Carotenoid fortification was not required; previously, the FDA Food Advisory Committee had considered carotenoid depletion by olestra, with most members concluding that they were reasonably certain that no harm would result from the effects of olestra on carotenoids *(10)*. In addition, FDA requires that olestra-containing products bear the label statement:

> "This product contains olestra. Olestra may cause abdominal cramping and loose stools. Olestra inhibits the absorption of some vitamins and other nutrients. Vitamins A, D, E, and K have been added."

Finally, FDA required Procter & Gamble to conduct studies monitoring olestra's consumption and its long-term effects. FDA announced its plans to review the data within 30 months of olestra's approval (June, 1998) *(10)*.

Procter & Gamble is now marketing "olean," its brand name for olestra, as an ingredient in snack products. Frito-Lay has become the first company to market a snack—potato chips—made with olestra *(11)*. Procter & Gamble has also announced plans to market its own brand of olestra-containing potato chips *(18)*.

Despite FDA approval of olestra, consumers have continued to protest the product. In particular, the Center for Science in the Public Interest has campaigned actively to inform the public of what it perceives to be the negative effects of olestra *(12)*. With olestra-containing products still available only in limited markets, the degree of consumer acceptance they will enjoy remains to be seen. However, during the first 4 weeks of test marketing in Indiana, 4 million servings of chips were sold and no complaints from consumers were received *(13)*. The popularity of snacks containing olestra (as measured by sales), along with the results of FDA's postmarket review of olestra's effects, could have a critical effect on future development and marketing of olestra-containing products. If sales are good and no negative effects are found, it may encourage the manufacturer to seek approval for olestra's inclusion in a broader range of products. If either the FDA review or consumer reaction is negative, olestra may fade from the scene.

Growth of Fat-Modified Foods

The Public Health Service's 1990 publication *Healthy People 2000: National Health Promotion and Disease Prevention Objectives* made a request of the food industry—a doubling of available lower fat foods by the year 2000 *(38)*. With consumer demand spurring industry on, this objective was accomplished quickly, as more than 1,000 fat-modified foods were introduced, on average, each year since 1990 *(20)*. By comparison, only 38 fat-modified products were introduced in 1981 *(26)*. At that time, there was less consumer demand for such products, and advanced technologies to produce reduced-fat foods were not available.

Types of Foods

Processed foods provide the greatest opportunity for fat modification because they can be reformulated to control their fat content. Even though the fat content of foods such as milk, meat, and eggs occurs naturally, it can be decreased through breeding or feeding practices *(26)*. For example, according to the National Cattlemen's Association and the Beef Industry Council, "the beef industry has succeeded in reducing the amount of fat in its products. Beef today has 27 percent less trimmable fat" than a decade ago *(27)*. Leaner meats are the result of improved breeding and meat-trimming practices *(16)*.

Frazao and Allshouse *(16)* used supermarket scanner data for 1989-93 to study the size and growth of the nutritionally improved foods market compared with their traditional counterparts. The 37 food categories used in their study accounted for 71 percent of volume sales captured by the scanner data in 1993. These nutritionally improved foods represented a steadily increasing proportion of retail food sales. Food

categories with nutritionally improved versions that had the largest percent growth in sales volume between 1989 and 1993 were dairy puddings, spaghetti sauce, cookies, whipping creams, popcorn, cream cheese, sour cream, and salad/cooking oils. The largest contributors to volume sales in 1993 were beverages—carbonated beverages, milk, fruit juices/drinks/ades, and beer *(16)*.

Fat-modified products make up a very large share of total products available among several product categories, including yogurt, refrigerated milk, and cottage cheese. Nonfat yogurt is so popular that whole milk yogurt accounts for only a small percentage of the yogurt market *(9)*.

Snacks

Fat-modified snack foods were eaten by 49 percent of consumers in 1996 compared with 39 percent in 1993 *(6)*. According to the Snack Food Association, fat-modified snack foods are the "fastest-growing products in the supermarkets." Between 1994 and 1995, fat-modified pretzels gained 339 percent in sales, whereas fat-modified varieties of tortilla chips gained 67 percent; potato chips, 48 percent; and cookies, 38 percent. Lowfat dips and salsas also gained in sales in 1995 *(11)*.

Table 4. Leading concerns about nutritional content of food, 1992-96[1]

Concern	Year				
	1992	1993	1994	1995	1996
	Percent				
Fat content, low fat	50	54	59	65	60
Salt/sodium content, less salt	21	26	18	20	28
Cholesterol levels	30	23	21	18	26
Sugar content/less sugar	13	18	14	15	12
Calories/low calorie	9	15	7	13	12
Vitamin/mineral content	8	10	6	8	12
Preservatives	11	8	10	11	8
Chemical additives	9	6	8	10	7
Food/nutritional value	5	10	4	8	6
Freshness/purity/no spoilage	5	3	5	7	5
Desire to be healthy/eat what's good for us	2	5	4	3	5
Ingredients/contents	5	5	2	6	4
As natural as possible/not overly processed	2	2	4	5	3
Chemicals	4	2	3	4	3
Getting a balanced diet	4	4	2	2	3

[1]Shoppers who were very or somewhat concerned about the nutritional content of their food were asked, "What is it about the nutritional content of what you eat that concerns you most?" (Multiple answers accepted.)

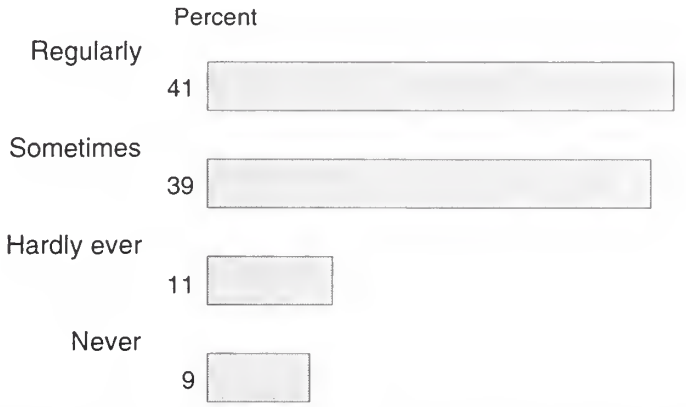
Source: Food Marketing Institute, 1996, Trends in the United States: Consumer Attitudes and the Supermarket, 1996.

The Influence of Federal Legislation

The Nutrition Labeling and Education Act (NLEA), which was signed in November of 1990 and went into effect in August of 1994, amends the Federal Food, Drug, and Cosmetic Act *(33)*. Under the NLEA, virtually all processed foods for sale must carry nutrition labeling that provides the amount of total fat and saturated fat per serving (as well as other nutrients). Also, the number of calories per serving derived from fat and any other source must be included *(33)*. As a result, consumers are able to compare the fat content of different types of foods and different brands of the same food. In addition, the NLEA restricts the types of claims that manufacturers can make on food products. The number of food products bearing fat-related health claims increased until 1993, when the number decreased dramatically. Although consumer demand for fat-modified products remained strong, the decrease in fat-related health claims can be attributed to the NLEA. By 1993, food manufacturers were labeling their products in anticipation of the August 1994 implementation date *(31)*.

FDA researchers found that between the spring of 1994 and the fall of 1995 (before and after NLEA implementation) there was a significant increase in the percentage of adults who often used food labels to obtain information on a food's nutrient content or for health claims applied to that food *(7)*. It appears that consumers are increasingly using food labels to make food choices based on fat content and other nutrients. In addition, consumers are more confident about the accuracy of label information *(31)*.

Figure 1. Percent of U.S. adults purchasing food products labeled low fat, 1995



Source: Derby, B.M. and Levy, A.S., 1996, Consumer and Market Impacts of the Nutrition Labeling and Education Act, Presentation made at the Marketing and Public Policy Conference, Rosslyn, VA, May 17.

Purchase Behavior/Consumption

According to the Calorie Control Council, 88 percent of American adults (90 percent of women and 87 percent of men) consumed fat-modified foods and beverages in 1996 *(6)*. Only 20 percent of adults never or hardly ever purchased lowfat food products (fig. 1) *(7)*.

As of 1996, 81 percent of shoppers had sought out and bought products labeled "low-fat" *(14)*. Fat is the main reason why shoppers selected the foods they did. Information about fat content on the nutrition label prompted 72 percent of shoppers to start buying a new food, compared with those who were motivated by information about sodium (13 percent), calories (9 percent), cholesterol (6 percent), and preservatives and additives (4 percent) *(15)*.

In 1996, consumers who used any fat-modified products on a regular basis were likely to use at least five: Milk, salad dressing/sauce/mayonnaise, cheese/dairy products, margarine, and chips/snack foods *(6)*. Three-quarters of these consumers used these products at least several times a week, and over half used them daily.

Concerns Regarding Consumption of Fat-Modified Foods

Increased consumption of fat-modified foods may seem to be a positive trend in American eating habits, since it could help achieve the Dietary Guidelines recommendation to reduce fat and saturated fat intake. Nevertheless, numerous concerns have been raised about these products—including those of safety, price, and diet quality.

Safety Concerns

The safety of food additives must always be considered, but fat substitutes merit particular study because, unlike most additives, they could potentially be consumed in very large quantities *(37)*. The FDA is responsible for the safety of food additives. Under the Federal Food, Drug, and Cosmetic Act, a substance is exempt from the definition of food additive and from premarket approval requirements if it is generally recognized as safe (GRAS) by qualified experts. Generally, substances that are identical or similar to traditional food ingredients are regulated under the GRAS exemption, whereas those that are truly novel are regulated as food additives.

Many of the products used as fat replacers, such as starches, gums, and cellulose, are also in common use as emulsifiers, gelling agents, stabilizers, and bulking agents and under those uses have long been approved for use by FDA. Thus, it is assumed that their use poses no health concerns. FDA, however, may re-examine approved substances should any concerns surface.

The microparticulated protein product Simplesse was the first ingredient announced by FDA specifically for use as a fat substitute. It is considered to be a GRAS product. Currently, there are two non-GRAS ingredients that have been approved as food additives for use as fat substitutes: Polydextrose and olestra. Although polydextrose was approved, it does have laxative effects when consumed in large amounts, and foods containing large amounts of polydextrose must carry a notification label. Olestra's possible side effects have raised considerable controversy (see box, pp. 20 and 21), but its use as a food additive was approved by FDA on the recommendation of the FDA Food Advisory Committee. Currently, its use is limited to one food category—savory snacks—and FDA plans to review the impact of olestra consumption no later than June 1998 (30 months after approval) *(10)*.

...more than 1,000 fat-modified foods were introduced, on average, each year since 1990.

Petitions have been filed with FDA regarding two other new fat substitutes, Caprenin and Salatrim *(2,3)*. These petitions affirm to FDA that Caprenin and Salatrim are GRAS. As a part of the process of filing a GRAS Affirmation Petition, FDA requires that any safety issues concerning the ingredient be addressed. The agency does not file petitions that do not address all criteria for GRAS status. Food manufacturers often begin using these products once the GRAS Affirmation Petition is filed with the FDA, because they believe it is unlikely that an ingredient's GRAS status will be challenged once the petition is filed. Salatrim, for example, is currently being marketed under the brand name Benefat™ *(2)*.

Other Physiological Effects

Some fat substitutes may have positive health properties. For example, Oatrim contains soluble fiber, which has been found to lower cholesterol *(3)*. Z-trim also has been cited as a potentially valuable fiber source *(34)*. Whether either of these substitutes will be consumed in sufficient quantities to have a significant impact on Americans' fiber intakes remains to be seen.

Price

Fat-modified food products may offer increased options for those following a lowfat diet, but only if the consumer can afford them. Results of a recent study by Frazao and Allshouse indicate that "nutritionally improved" food items (a category that included fat-modified, sodium-modified, and other foods that were modified nutritionally) generally cost more per pound in 1993 than their regular versions (for 30 of 37 food categories studied) *(16)*.

This price differential may have affected consumer perception of the cost of healthful diets. A 1996 survey of shoppers found that 58 percent agreed with the statement "it costs more to eat healthful foods," up from 43 percent in 1992 *(15)*. It is, of course, possible to eat a healthful diet by making appropriate choices from regular food items. But if consumers perceive that it is necessary to purchase fat-modified food products in order to follow a lowfat diet, the higher prices of many of these items may be a barrier to dietary change.

Impact on Diet Quality

Fat-modified foods' potential role in decreasing fat intake has generated considerable interest. Since many, though not all, of these foods are also reduced in calories, it has also been suggested that their use might help Americans achieve or maintain a healthy weight. In addition, some research suggests that a lower fat diet may be beneficial for weight loss because fat compared with carbohydrate is more efficiently converted to adipose tissue *(17)*.

Detractors have argued that there is no proof that use of these products leads to an overall diet that is lower in fat and/or calories. They further contend that if consumers rely on fat-modified foods rather than changing basic eating patterns, this may lead to consumption of diets that are less healthful in terms of intake of vitamins, minerals, and other dietary essentials.

Effects of Fat-Modified Food Use on Overall Fat and Caloric Intake

Researchers have attempted to model the potential impact of regular use of fat-modified food products on diet quality. Lyle et al. *(24)* estimated that fat intake could be reduced to 30 percent of calories and average caloric intake decreased by

approximately 800 calories per week if fat-free products in several food categories (cheeses, sour cream, frozen desserts, commercial sweet baked goods) were substituted for their regular versions.

In real life, however, consumers may act differently than the model suggests. Consumers may eat reduced-fat foods in larger amounts or otherwise compensate for the reduced-fat (and sometimes calorie) content of some foods by eating more of other foods. To confirm whether consumption of reduced-fat foods is associated with an overall diet reduced in either fat or calories, studies of actual eating behavior are needed.

Experimental Data

Studies in which subjects were surreptitiously fed reduced-fat, reduced-calorie versions of familiar foods have generally shown that healthy, normal-weight subjects compensated for the reduced calories in the lowfat foods by eating more of other foods. They did not seek out high fat foods to compensate for the reduction in fat calories. Instead, they ate more of their usual mix of foods, resulting in a net decrease in fat intake but not in caloric intake *(17)*. One study, conducted with overweight individuals, showed incomplete caloric compensation when subjects were surreptitiously fed reduced-fat, reduced-calorie foods, resulting in a net reduction in both fat and calorie consumption *(19)*.

A special concern is the potential impact of consumption of fat-modified food products on children's energy intake. If a child's caloric intake were reduced by excess consumption of reduced-fat products, this might compromise growth. Even if these products are not marketed towards children, it could reasonably be expected that if they are widely consumed there will be at least some children who will eat them regularly. Few studies of the impact of consumption of fat-modified food products on children's diets have been done. One study, conducted by Birch et al. *(5)*, indicates that preschool-age children, like normal-weight adults, compensate for the reduction in calories but not for the reduction in fat when fed reduced-fat, reduced-calorie foods. More studies with children of differing ages would be helpful in fully assessing any potential impacts of these products on childhood diets *(4)*.

Potential Impacts of Consumers' Beliefs About Fat-Modified Foods on Diet

The experimental studies described above were conducted with individuals who did not know they were consuming foods that were reduced in fat and calories. Therefore, their changes in eating behavior reflect the influence of physiological factors only. In normal circumstances, individuals know they are consuming fat-modified food products, and this awareness may influence their behavior. For example, individuals may react by eating more of the fat-modified food product or by eating more of other foods. Such a reaction could negate the reduction in fat or calories associated with consumption of reduced-fat foods or even lead to a diet higher in fat or calories if the individual miscalculates.

Advertising and promotional strategies may encourage consumers to believe that eating more of fat-modified food products is acceptable. According to one national survey conducted in 1996, about one-third of shoppers believed that it was alright to eat larger amounts of lowfat or fat-free products than the regular variety. This percentage, though large, was down from 42 percent the previous year, indicating that consumers may be learning that fat-free is not calorie-free *(15)*.

Evidence that consumption of fat-modified food products may lead to overconsumption of other foods was provided by a study by Shide and Rolls *(29)*, who found that when women knew they had eaten a lowfat food for breakfast, they ate more fat and calories at later meals than they would normally. However, this was a short-term study, examining food consumption behavior only over a 1-day period in a laboratory setting. Whether this effect would persist over time and/or would occur in a real-life situation would need to be established by other studies, including studies conducted with a free-living population.

Food Consumption Survey Data

The best information to date on the impact of consumption of fat-modified foods on the average consumer's eating habits comes from analysis conducted by van der Reit et al. using data from USDA's Nationwide Food Consumption Survey 1987-88 and Continuing Survey of Food Intakes by Individuals 1989-91 and 1994 *(39)*. These surveys collected dietary data from national samples of individuals including data on the use of fat-modified food products and its impact on the overall diet.

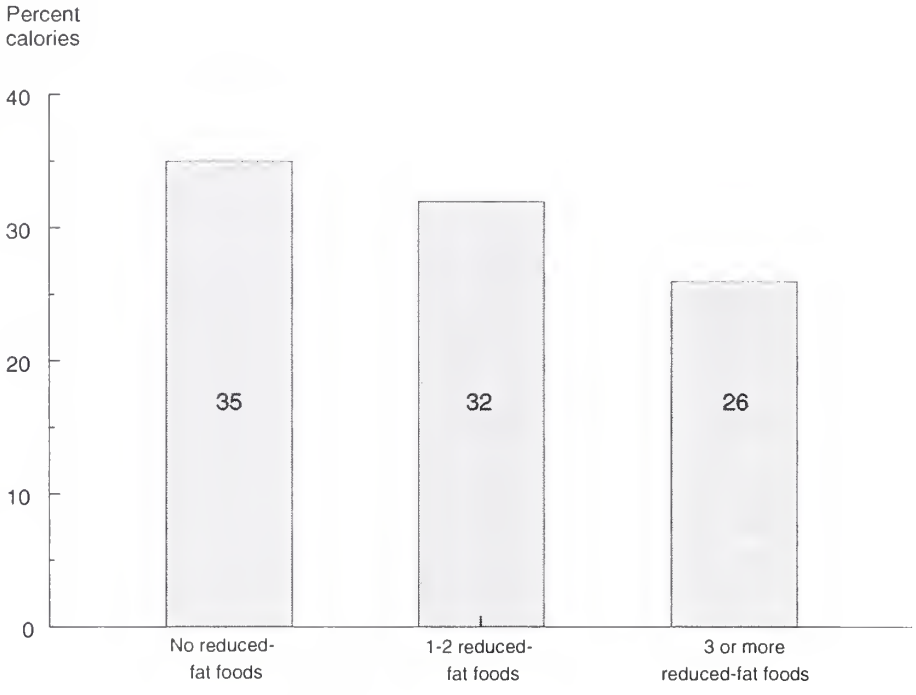
The researchers found no evidence of a tendency to overconsume reduced-fat foods. These foods were usually eaten in the same or smaller amounts as their regular versions. Use of reduced-fat foods was associated with a decrease in total fat intake. Nonusers of reduced-fat foods averaged 35 percent of calories from fat; those who used one or two reduced-fat foods averaged 32 percent calories from fat, and those consuming three or more reduced-fat foods had average fat intakes of 26 percent of total calories (fig. 2).

Saturated fat intake showed a corresponding decline, with nonusers of reduced-fat foods consuming 12 percent of calories from saturated fat, compared with an intake of 8 percent of calories from saturated fat among those using three or more reduced-fat products *(39)*. These differences in fat and saturated fat intakes may reflect not only the use of reduced-fat food products but also a tendency to choose traditional foods that are naturally lower in fat and/or to prepare foods with less fat. Nevertheless, these findings do not support the assertion that consumers of fat-modified food products may compensate by increasing fat intake from other foods.

These decreases in fat and saturated fat intake were consistently found among population subgroups defined by age and sex or by racial/ethnic identification. The associations between use of reduced-fat foods and total caloric intake were less consistent. Among the total population, users of reduced-fat food products had total caloric intakes that were slightly higher than those of nonusers: 1,805 kcal/day for nonusers; 1,860 kcal/day for users of one to two reduced-fat food products; and 1,837 kcal/day for those using three or more reduced-fat food products (fig. 3). But within population subgroups, the associations were not consistent. For example, teenage males who used reduced-fat food products had higher caloric intakes than those who did not, but for female teenagers, the reverse was true *(39)*. It is possible that different subgroups are using reduced-fat foods for different purposes—some to restrict both fat and calories and some to reduce fat only. It also is possible that some are simply more successful in using reduced-fat foods as part of an overall calorie reduction strategy. More examination of the motives for using fat-modified foods and related effects on caloric intake among specific population subgroups is needed.

These data suggest that for many individuals, use of fat-modified foods may be an effective strategy for decreasing the fat content of their diets. Research by Kristal et al. *(23)* indicates that it may also be a strategy that consumers find relatively easy to adopt and maintain, compared with other strategies that require more basic changes in eating habits, such as limiting the use of fats as spreads or flavorings.

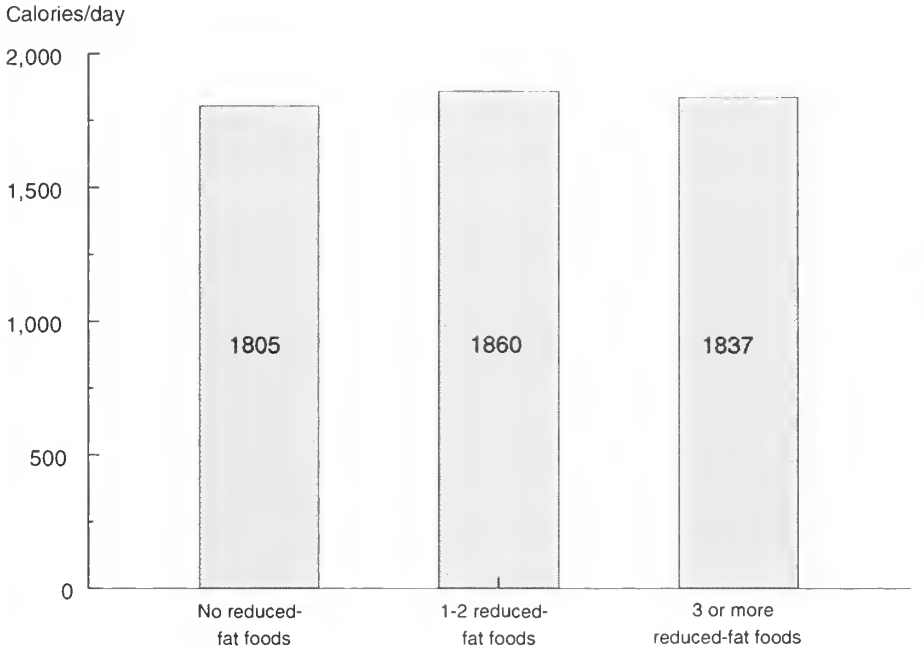
Figure 2. Fat intake by use of reduced-fat food products, 1987-94[1]



[1]All food and nutrient consumption data are derived from the following surveys conducted by USDA: 1987-88 Nationwide Food Consumption Survey, Individual Intake Component; 1989-90 CSFII; 1990-91 CSFII; 1991-92 CSFII; and 1994 CSFII.

Source: van der Reit et al., 1996, Impact of the use of reduced fat foods on nutrient adequacy. Speech presented at the Conference on Nutritional Implications of Macronutrient Substitutes, New York Academy of Sciences, Arlington, VA, October 29.

Figure 3. Calorie intake by use of reduced-fat food products, 1987-94[1]



[1]All food and nutrient consumption data are derived from the following surveys conducted by USDA: 1987-88 Nationwide Food Consumption Survey, Individual Intake Component; 1989-90 CSFII; 1990-91 CSFII; 1991-92 CSFII; and 1994 CSFII.

Source: van der Reit et al., 1996, Impact of the use of reduced fat foods on nutrient adequacy. Speech presented at the Conference on Nutritional Implications of Macronutrient Substitutes, New York Academy of Sciences, Arlington, VA, October 29.

Little research has been done on the overall quality of the diets of people consuming fat-modified food products.

Effects of Fat-Modified Food Use on Overall Diet Quality

Some nutritionists are concerned that use of fat-modified food products as a primary strategy for decreasing fat intake may result in diets of lower quality than if people lowered dietary fat by making changes in their basic eating patterns *(21,32)*. Traditional lowfat diets may be valuable not only because of their decreased fat content, but also because an increased intake of fruits, vegetables, and grains usually accompanies the decrease in fat. Diets rich in fruits, vegetables, and grains may contain more vitamins, minerals, fiber, and potentially beneficial phytochemicals than lowfat diets that consist mainly of reduced-fat versions of cookies, chips, and other products *(21)*.

Little research has been done on the overall quality of the diets of people consuming fat-modified food products. Van der Reit et al. examined the association of consumption of reduced-fat food products with intakes of two vitamins—A and E; and two minerals—iron and zinc *(39)*. The researchers found that vitamin A and iron intakes were higher

among users of reduced-fat food products in the total population and among subpopulations identified by age, sex, and ethnicity. In the total population, users and nonusers of reduced-fat food products had similar intakes of vitamin E. Within population subgroups, there were differences in vitamin E intake between users and nonusers that seemed to parallel differences in caloric intake.

Similarly, zinc intakes of users of reduced-fat food products were higher in the total population, but within population subgroups, there were differences that corresponded to differences in caloric intake *(39)*. These results do not demonstrate any negative effects of inclusion of reduced-fat food products in the diet. However, examination of any effects on intakes of other dietary components, particularly those such as carotenoids and dietary fiber for which plant-based foods are sources, is indicated.

Conclusions and Recommendations

Fat-modified foods have rapidly become a significant part of the American food supply, but their value as a means of improving the diets of Americans remains to be established. More research is needed to verify the nutritional benefits claimed for these products and/or identify any negative effects they may have.

Several research studies have been consistent in finding that consumption of fat-modified food products may be helpful for reducing fat intake. Their use does not seem to reduce calorie intake among most population segments; therefore, their value for weight control is doubtful. There is no evidence that regular use of fat-modified food products results in reduced vitamin or mineral intake or other decreases in diet quality. The research in this area is so limited, however, that it is premature to draw conclusions. Much more research examining the impact of the use of fat-modified food products on diet quality needs to be done.

The growing popularity of fat-modified food products offers challenges and opportunities for those engaged in nutrition education and promotion. Educational and promotional strategies are needed to help consumers realize that consumption of fat-modified foods will not automatically result in either a lowfat diet or weight reduction *(21)*. There is evidence that consumers are able to assimilate these messages; for example, consumer beliefs that one can eat more of foods if they are lowfat have declined *(15)*. Where economics is a concern, it is important that consumers realize that a lowfat diet can also be achieved using appropriately chosen conventional foods, since many fat-modified foods are more expensive than their regular counterparts.

Finally, those engaged in nutrition education and promotion must strive to develop messages that convince consumers that eating no more than 30 percent of calories from fat, while important, is not the only characteristic of a healthy diet. These messages should also motivate consumers to consume a diet with recommended amounts of fruits, vegetables, and grains. Ideally, it will be possible to capitalize on the consumer interest roused by fat-modified food products and use that interest to change overall eating habits that conform to the recommendations of the *Food Guide Pyramid* and the *Dietary Guidelines for Americans.*

References

1. The American Cancer Society 1996 Dietary Guidelines Advisory Committee. 1996. *Guidelines on Diet, Nutrition, and Cancer Prevention: Reducing the Risk of Cancer with Healthy Food Choices and Physical Activity.* American Cancer Society.

2. American Dietetic Association. 1996. Salatrim means less fat...fewer calories... more taste! The American Dietetic Association Fact Sheet for Dietetics Professionals. National Center for Nutrition and Dietetics, Chicago.

3. American Dietetic Association. 1991. ADA reports: Position of The American Dietetic Association: Fat replacements. *Journal of the American Dietetic Association* 91(*10*):1285-1288.

4. Birch, L.L. and Fisher, J.O. 1997. Food intake regulation in children. *Annals of the New York Academy of Sciences* 819:194-220.

5. Birch, L.L., Johnson, S.L., Jones, M.B., and Peters, J.C. 1993. Effects of a nonenergy fat substitute on children's energy and macronutrient intake. *American Journal of Clinical Nutrition* 58:326-333.

6. Calorie Control Council. 1996. *Calorie Control Commentary* 18(*1*):1-5.

7. Derby, B.M. and Levy, A.S. 1996. Consumer and Market Impacts of the Nutrition Labeling and Education Act. Presentation made at the Marketing and Public Policy Conference, Rosslyn, VA, May 17.

8. FDA Backgrounder. 1995. Olestra and other fat substitutes. BG95-18, November 28 issue.

9. Fensholt, C. 1996, February. Reiterating the 30% rule. *Supermarket Business,* pp. 37-39.

10. Food and Drug Administration. 1996. FDA Approves Fat Substitute, Olestra. Press Release. January 24 issue.

11. *Food Labeling and Nutrition News.* 1996. Snack sales drop. Vol.4 No.41, p.12.

12. *Food Labeling and Nutrition News.* 1996. CSPI campaigns in 'Diarrhea Capitals' to inform public of alleged olestra dangers. Vol.4 No.*37*, p.12.

13. *Food Labeling and Nutrition News.* 1997. CSPI takes anti-olestra campaign to Indianapolis. Vol.5 No.26, pp.7-8.

14. Food Marketing Institute. 1996. *Trends in the United States: Consumer Attitudes and the Supermarket, 1996.*

15. Food Marketing Institute and Prevention Magazine. 1996. *Shopping for Health 1996: Americans Look for Answers About the Foods They Eat.*

16. Frazao, E. and Allshouse, J.E. 1996. *Size and Growth of the Nutritionally Improved Foods Market.* U.S. Department of Agriculture, Economic Research Service. Agriculture Information Bulletin No. 723.

17. Gershoff, S.N. 1995. Nutrition evaluation of dietary fat substitutes. *Nutrition Reviews* 53(*11*):305-313.

18. Giese, J. 1996, March. Olestra: Properties, regulatory concerns, and applications. *Food Technology,* pp. 130-131.

19. Glueck, C.J., Hastings, M.M., Allen, C., Hogg, E., Baehler, L., Gartside, P.S., Phillips, D., Jones, M., Hollenbach, E.J., Braun, B., and Anastasia, J.V. 1982. Sucrose polyester and covert caloric dilution. *American Journal of Clinical Nutrition* 35:1352-1359.

20. *International Food Information Council Foundation.* 1995, November. Uses and nutritional impact of fat reduction ingredients.

21. Kantor, M.A. 1996, July-August. Olestra: Questions still unanswered. *Journal of Nutrition Education,* pp. 191-192.

22. Krauss, R.M., Deckelbaum, R.J., Ernst, N., Fisher, E., Howard, B.V., Knopp, R.H., Kotchen, T., Lichtenstein, A.H., McGill, H.C., Pearson, T.A., Prewitt, E., Stone, N.J., Van Horn, L., and Weinberg, R. 1996. Dietary Guidelines for healthy American adults: A statement for health professionals from the Nutrition Committee, American Heart Association. *Circulation* 94:1795-1800.

23. Kristal, A.R., White, E., Shattuck, A.L., Curry, S., Anderson, G.L., Fowler, A., and Urban, N. 1992. Long-term maintenance of a low-fat diet: Durability of fat-related dietary habits in the Women's Health Trial. *Journal of the American Dietetic Association* 92:553-559.

24. Lyle, B.J., McMahon, K.E., and Kreutler, P.A. 1992. Assessing the potential dietary impact of replacing dietary fat with other macronutrients. *Journal of Nutrition* 122:211-216.

25. McGinnis, J.M. and Foege, W.H. 1993. Actual causes of death in the United States. *Journal of the American Medical Association* 270(*18*):2207-2212.

26. Morrison, R.M. 1994. Fat substitutes in foods: Growing demand and potential markets. *In* C.C. Akoh and B.G. Swanson (Eds.) *Carbohydrate Polyesters as Fat Substitutes* (pp. 237-249). Marcel Dekker, Inc., New York.

27. National Cattlemen's Association and the Beef Industry Council. 1996. Press Release: Statement Regarding the 1995 Dictary Guidelines for Americans. January 2.

28. Oster, G. and Thompson, D. 1996. Estimated effects of reducing dietary saturated fat intake on the incidence and costs of coronary heart disease in the United States. *Journal of the American Dietetic Association* 96(2):127-131.

29. Shide, D.J. and Rolls, B.J. 1995. Information about the fat content of preloads influences energy intake in healthy women. *Journal of the American Dietetic Association* 95(9):993-998.

30. Sloan, A.E. 1996, July. America's appetite '96: The top 10 trends to watch and work on. *Food Technology*, pp. 55-71.

31. Stillings, B.R. 1994. Trends in foods. *Nutrition Today* 29(5):6-13.

32. Thomas, P.R. 1996, July-August. Olestra: Another technological fix for the food supply. *Journal of Nutrition Education*, pp. 193-194.

33. U.S. Congress. 1990. Public Law 101-535: Nutrition Labeling and Education Act of 1990. 21 USC 301.

34. U.S. Department of Agriculture, Agricultural Research Service. 1996. *USDA Develops Tasty No-Cal, High-Fiber Fat Substitute.* USDA press release, August 26, PR-1396.

35. U.S. Department of Agriculture, Agricultural Research Service, Food Survey Research Group. 1996. Data Tables: Results from USDA's 1995 Continuing Survey of Food Intakes by Individuals and 1995 Diet and Health Knowledge Survey. *On* CSFII/DHKS 1995 CD-ROM.

36. U.S. Department of Agriculture and U.S. Department of Health and Human Services. 1995. *Nutrition and Your Health: Dietary Guidelines for Americans.* (4th ed.) Home and Garden Bulletin No. 232.

37. U.S. Department of Health and Human Services, Food and Drug Administration. 1995, November. Olestra and other fat substitutes. [On-line]. Available: http://www.fda.gov...nders/olestra.html

38. U.S. Department of Health and Human Services, Public Health Service. 1991. *Healthy People 2000: National Health Promotion and Disease Prevention Objectives.* DHHS Publication No. (PHS) 91-50212.

39. van der Riet, B.E., Heimbach, J.T., and Egan, S.K. 1996. Impact of the use of reduced fat foods on nutrient adequacy. Speech presented at the Conference on Nutritional Implications of Macronutrient Substitutes, New York Academy of Sciences, Arlington, VA, October 29.

40. Welsh, S. and Guthrie, J.F. 1991. Changing American diets. *In* A. Bendich and C.E. Butterworth, Jr. (Eds.) *Micronutrients in Health and in Disease Prevention* (pp. 381-408). Marcel Dekker, Inc., New York.

Supplement Use May Not Be Associated With Better Food Intake in All Population Groups

David L. Pelletier
Anne Kendall

Division of Nutritional Sciences
Cornell University

This study tests the generalization from earlier studies that food intake of supplement users is more healthful than that of nonusers and finds that the association varies across major population groups. Data on adults from the 1989-91 Continuing Survey of Food Intakes by Individuals (CSFII) were analyzed by multiple regression to test for (1) confounding by sociodemographic factors; and (2) whether the strength and direction of the relationship among supplement use and healthfulness of diet is similar across population groups defined by ethnicity, age, sex, and nutrition knowledge and attitudes. The results indicate that sociodemographic factors do not account for the positive association between supplement use and nutrient intake from food. However, the presence of statistically significant interactions between supplement use and ethnicity, age, sex, and nutrition knowledge, attitudes, and beliefs reveals that the strength and direction of this association varies across major population groups. This is in contrast to the generalization that emerged from 13 previous studies. These findings deserve confirmation in larger national samples and have implications for nutrition education and regulatory policies concerning nutrient supplements.

For many years, the professional medical and nutrition communities in the United States have taken the position that the nutritional requirements for most nutrients in most people can and should be met by consuming an appropriately balanced diet. A corollary is that dietary improvement should be the first line of intervention to prevent or correct nutritional imbalances when they do occur, and that the use of nutrient supplements should not be part of a broad, population-based strategy for health promotion and disease prevention. This view is evident in a joint statement from the American Dietetics Association, the American Institute of Nutrition, the American Society for Clinical Nutrition, and the National Council Against Health Fraud *(2)*.

In stark contrast to this professional opinion, the use of nutrient supplements is quite common in the U.S. population, and the prevalence increased from 1977-78 to 1986 *(15)*. The 1987 Health Interview Survey indicates that 51 percent of the adult population used one or more supplements in the past year and 23 percent did so daily *(24)*. Whites, women, and older adults are more likely to consume supplements regularly than are Blacks, Hispanics, men, and younger adults.

The National Research Council report on diet and health noted that physicians and pharmacists have a strong influence on patient decisions to use supplements in addition to the effects of marketing, the media, and other sources of information *(15)*. The influence of industry marketing may increase in the future as a result of the Dietary Supplement Health and Education Act enacted in October 1994, which requires a much more permissive regulatory policy than that sought by the Food and Drug Administration *(17)*. The proposal to permit the use of food stamps for purchasing supplements (H.R. 236, 1995), although defeated, could have further increased supplement use among low-income households.

One area of disagreement about the appropriate role of supplements and food-based approaches involves the relationship between so-called antioxidant nutrients and chronic disease. Although chronic disease morbidity and mortality show strong and consistent associations with the consumption of fruits and vegetables, they have inconsistent associations with antioxidant intake from diet and/or supplements *(1,7,15,16)*. This has led to the suggestion that the preventive effects of fruits and vegetables may relate to other constituents of food and that serum antioxidant levels may be simply markers of a diet that is habitually high in these foods *(12)*. If valid, this hypothesis would add further support for a food-based approach and call into question the advisability of using a supplement-based approach.

These findings raise the question of the extent to which the public is using supplements as a substitute for healthful diets or as a complement to such diets. Most studies suggest that the nutrient intake from food is either similar to or higher among supplement users as compared with nonusers *(4,6,10,11,22,25)*. These same studies have established that supplement use is associated with a variety of socioeconomic and attitudinal characteristics that may confound, modify, and/or mediate that relationship, but most have not taken these factors into account in the analysis.

The purpose of the present study is: (1) to examine the association between supplement use and dietary intake after accounting for socioeconomic factors; (2) to examine the consistency of this finding across various sociodemographic groups; and (3) to examine the consistency of these findings across groups that vary in nutrition knowledge, attitudes, and beliefs.

Methods

This study uses data from the 1989-91 Continuing Survey of Food Intakes of Individuals (CSFII). The CSFII is a multistaged, stratified probability sample, representative of the 48 contiguous States and is intended to be representative of the U.S. population in these States. The present study is limited to adults (20 years or older) of both sexes with complete sociodemographic and dietary data, of which 8,865 were included in the survey. A sample of 7,361 individuals is used in the sociodemographic analysis, representing those with nonmissing and nonextreme values (i.e., within three standard deviations of the mean) for the dietary and socioeconomic variables. A further subsample, consisting of 2,895 females, is used in analyses involving nutrition knowledge, attitudes, and beliefs (KAB) variables. This is because the KAB module was administered to only the main meal planner/preparer in the CSFII, 83 percent of whom are female in this sample.

The dietary data used here are based on a single 24-hour recall for each subject. Total nutrient intake from food and beverages for seven key nutrients is examined—total fat and saturated fat, dietary fiber, vitamin A (retinol equivalents), vitamin C, calcium, and iron. All nutrients are expressed in relation to energy intake on the day of the recall to form nutrient density indices that are independent of energy intake and, thus, more indicative of diet quality. These indices were examined for skewness prior to analysis and transformed as recommended elsewhere *(14)*. Total fat was found to be normal in its natural scale, a square root transformation was applied to saturated fat, and a natural log transformation was applied to the other five nutrients.

Each of the seven nutrients is examined separately, and they are also combined into an overall dietary score. The dietary score is calculated for each individual as the average Z-score of the seven transformed nutrients, using the sample of 7,361 individuals to estimate the internal means and standard deviations. The sign of the Z-score was reversed for total and saturated fat prior to summing across all nutrients, so that the average Z-score would have a consistent interpretation (i.e., positive or higher Z-score values indicate relatively nutrient dense or healthful diets). This dietary score is considered important in this context because it more closely reflects the overall quality of the diet (with respect to these seven nutrients) than any one nutrient by itself.

Socioeconomic and demographic (hereafter termed "sociodemographic") variables include age, sex, ethnicity, household income, education, and employment status. The categories defined for each of these variables are shown in table 1 along with the sample sizes and percentage of individuals reporting supplement use in each category. Three ethnic groups are defined: non-Hispanic Whites ("Whites"), non-Hispanic Blacks ("Blacks"), and anyone reporting Hispanic origin ("Hispanic").

Ten indices of nutrition knowledge, attitudes, and beliefs were created from the KAB module and used in preliminary analyses. Four of these were chosen for further analysis, based on the consistency of their statistical interaction with supplement use and nutrient intake. These four relate to: (1) knowledge of diet and heart disease relationships (binary responses to six questions); (2) agreement with the statement that, "There are so many recommendations, it is hard to know what to believe" (six-point Likert scale); (3) agreement with the statement that, "Things I eat are healthy, so there is no need to change" (six-point Likert scale); and (4) responses indicating an attitude that many dietary recommendations are not important (six-point Likert scale for each of 12 questions). The total score for each of these four items was converted to a binary variable for analysis, in each case using the median score for the total sample as the cutoff point.

Users of supplements are defined based on the question, "How often, if at all, do you take a vitamin or mineral supplement?" Users are defined as those reporting the use of any type of supplement "every day" or "every so often," and nonusers are defined as those reporting "not at all."

The relationships among dietary intake, supplement use, sociodemographic variables, and KAB variables are examined using multiple regression analysis. Three sets of analyses were conducted: (1) main effects models were used to test whether the positive association between supplement use and dietary intake can be accounted for by sociodemographic variables. Each nutrient (and the dietary score) is used as a dependent variable in its own model, and the statistical effect of supplement use is observed before and after adjusting for the sociodemographic variables as a set (i.e., income, education, occupation, age, sex, and ethnicity); (2) interaction models were used to test whether the strength or direction of the association is uniform across age, sex, and ethnic groups while controlling for income, education, and occupation. This is done by testing the significance of an entire block of interactions between supplement use and age, sex, and ethnicity after controlling for the above-mentioned variables; (3) in similar fashion, interaction analysis is used to test whether the strength or direction of the association varies according to individual nutrition knowledge, attitudes, and beliefs. In this case, a set of interactions between supplement use, KAB variables, and ethnicity is tested. This third set of analyses was conducted separately for younger (20-49 years) and older (50 years and older) females. This was done in order to simplify the interpretation of interaction terms.

The statistical methods described above are designed to permit a valid test of the null hypothesis that the strength or direction of the association between supplement and nutrient intake from food is uniform across groups defined by sociodemographic or KAB variables. In this study, such a test is obtained by comparing the proportion of variance explained by the full model (containing all interaction terms involving the "supplement use" variable) versus the reduced model (containing no such interaction terms). Since the array of model coefficients is difficult to interpret in the presence of higher order interaction terms, graphs are used to gauge the direction and magnitude of the differences in nutrient intake implied by these models.

Preliminary analyses were conducted using SAS *(18)* and proportionate sample weights. These analyses were confirmed using SUDAAN to account for the effects of the complex sample design on variance estimates, and all results presented here are derived from SUDAAN *(19)*.

Results

Table 1, p. 36 is presented for descriptive purposes, in order to understand the variation in supplement use across the various sociodemographic and KAB variables used in later regressions. Supplements are reportedly used by roughly 33 to 43 percent of U.S. adults in this sample. Usage is higher among Whites than non-Whites and among females compared with males. Usage is higher among older adults. Usage is also higher among those with incomes greater than 170 percent of poverty, among those with 12 or more years of education, and among the employed. Usage is positively associated with greater knowledge about diet-heart relationships, with a belief that one's diet does not need to change, and with the belief that nutrition is unimportant.

In agreement with previous studies, table 2, p. 37, reveals that supplement users have slightly lower mean fat and saturated fat densities and higher mean densities of all other nutrients (fiber, vitamins A and C, calcium, and iron). When averaged across all seven nutrients, as seen in the mean diet score, the average diets of users are superior to those of nonusers. As shown, controlling for sociodemographic variables diminishes the differences in mean density between users and nonusers for most nutrients and for the diet score, but all of the differences remain statistically significant (or nearly so in the case of total fat, with $p=0.054$).

The test of uniformity of these results across major population groups is contained in table 3, p. 38. This test takes the form of F-statistics for the R^2 improvement associated with the total block of 11 interactions, as shown in the bottom row. The table also shows the regression coefficients for all variables in the models (which are used in the next section to calculate predicted means). The F-statistic reveals that the strength and/or direction of the association between supplement use and nutrient density is not uniform across all population groups. The interaction reaches statistically significant levels for fat ($p<0.001$), saturated fat ($p<0.001$), fiber ($p<0.001$), vitamin A ($p<0.001$), vitamin C ($p<0.001$), iron ($p<0.01$), and the diet score ($p<0.001$). The only equation in which the block of interactions is not significant is that for calcium.

Having determined that the association between supplement use and nutrient density does vary significantly across major population groups, a series of predicted means was estimated from the regression equations in order to assist interpretation. Inspection of these predicted means reveals that supplement use is indeed associated with more healthful nutrient profiles in some groups. However, these predicted means also reveal that supplement use is associated with little or no differences in nutrient profiles in other population groups. The example of middle-aged females and males is illustrated in figure 1, p. 39.

When the dietary means for supplement users are expressed as a percentage of that for nonusers (to standardize the comparison across nutrients), figure 1 shows that female Hispanic users have 14 percent lower total fat density, 22 percent lower saturated fat density, and higher densities for all other nutrients (ranging from 19 to 86 percent higher) than their nonusing counterparts. Thus, the mean diet score is .38 Z-scores higher for users compared with nonusers. However, this is in contrast to the pattern in several other groups. For instance, the figure shows that female White and

...the association between supplement use and nutrient density does vary significantly across major population groups...

Table 1. Supplement use stratified by sociodemographic and knowledge, attitudes, and beliefs variables, U.S. population, 1989-91 CSFII

Variable	Both sexes (N = 7,361)		Men (N = 3,079)		Women (N = 4,282)	
	Percent[1]	N	Percent	N	Percent	N
Ethnicity						
White (R)[2]	43.3	5,878	33.6	2,548	52.2	3,330
Black	34.7	865	29.0	275	39.1	590
Hispanic	32.5	618	22.2	256	43.0	362
Age (years)						
20 - 49 (R)	38.1	4,329	28.8	1,891	47.3	2,438
50 and older	47.8	3,032	39.2	1,188	54.5	1,844
Income (Percent of poverty)						
<100 (R)	29.6	1,807	21.1	590	39.1	1,217
100 - 170	31.5	1,696	18.0	681	41.2	1,015
>170	44.7	3,858	35.2	1,808	54.2	2,050
Education						
Less than high school (R)	30.8	2,176	21.7	865	38.4	1,311
High school or some college	43.1	4,015	33.2	1,624	51.2	2,391
College degree or more	46.2	1,170	36.9	590	57.2	580
Occupation						
Unemployed (R)	39.3	3,911	31.1	2,038	49.0	1,873
Employed	45.7	3,450	35.3	1,041	51.4	2,409
	Both sexes (N = 3,489)		Men (N = 594)		Women (N = 2,895)	
Heart health knowledge[3]						
<Median (R)	42.9	1,309	25.6	241	47.5	1,068
>Median	50.2	2,180	37.8	353	53.1	1,827
Too many recommendations						
Weak/no agreement (R)	50.4	1,293	33.9	207	54.2	1,086
Strong agreement	46.3	2,196	33.7	387	49.4	1,809
No need to change						
Weak/no agreement (R)	43.2	1,412	30.1	230	46.3	1,182
Strong agreement	51.2	2,077	36.5	364	55.2	1,713
Nutrition is unimportant						
Weak/no agreement (R)	44.2	1,624	33.4	348	47.7	1,276
Strong agreement	51.3	1,865	34.4	246	54.2	1,619

[1]The percentage using supplements reflects weighting; the sample size refers to the actual number of people with complete data as used in this analysis.
[2](R) indicates the reference group in the regression analysis.
[3]Knowledge of diet-heart disease relationships.

Table 2. Nutrient intakes of supplement users and nonusers and coefficients for supplement use in multiple regression models

Nutrient	Mean		Supplement coefficient					
			Unadjusted			Adjusted[1]		
	Users (N = 2,844)	Nonusers (N = 4,517)	B	SE (B)	Probability	B	SE (B)	Probability
Fat (% kcals)	33.6	34.5	–.724	.216	.0008	–.423	.220	.054
Saturated fat (% kcals)[2]	9.2	11.4	–.070	.014	.0001	–.051	.014	.0004
Fiber (g/1,000 kcals)[3]	7.5	7.0	.082	.012	.0001	.057	.012	.0001
Vitamin A (RE/1,000 kcals)[3]	455	372	.196	.020	.0001	.141	.020	.0001
Vitamin C (mg/1,000 kcals)[3]	41.3	34.8	.169	.022	.0001	.117	.022	.0001
Calcium (mg/1,000 kcals)[3]	376	354	.066	.012	.0001	.042	.012	.0007
Iron (mg/1,000 kcals)[3]	7.2	7.0	.043	.010	.0001	.029	.010	.0036
Diet score (Z-score)	+.08	–.06	.143	.014	.0001	.098	.014	.0001

[1]Models include income, education, employment status, age, sex, and ethnicity in addition to a dummy variable indicating supplement use.
[2]Square root transformation applied in regressions; geometric means are shown to facilitate interpretation.
[3]Natural log transformation applied in regressions; geometric means are shown to facilitate interpretation.

Black supplement users have nutrient densities that are more similar to those of their nonuser counterparts. Thus, while the mean diet score for users is 13 percent higher for Whites, it is only 1 percent higher for Blacks.

In a second comparison, the figure shows that the more healthful diet of Hispanic females is not replicated among Hispanic males (the mean diet score is .02 Z-scores higher for users compared with nonusers). A third example of subpopulation differences is that supplement use among Black females has little or no association with nutrient density (mean diet score=.01 Z-scores higher than nonusers). However, among Black males, supplement use is associated with 10 to 12 percent lower fat and saturated fat densities and 9 to 54 percent higher densities for the other nutrients, such that the mean diet score is .37 Z-scores higher among users compared with nonusers.

The magnitude of these differences is not estimated with precision in these analyses because of small sample sizes. When combined with the significant F statistics from table 3, however, they are sufficient to indicate that significant variation does exist in the strength and/or direction of the association between supplement use and nutrient density across distinct population groups.

Building upon evidence from an earlier study *(25)*, it was hypothesized that the above findings may reflect differences in the underlying motivations for using supplements and associated knowledge, attitudes, and beliefs concerning food, diet, and health. Table 4, p. 40, presents the F-values for the block of interactions between supplement use, ethnicity, and the four KAB variables (each KAB variable in its own model), after controlling for sociodemographic variables. This table contains the results for females only because the KAB module was administered to the main meal planners, most of whom are female. Separate analyses were conducted for younger (20-49 years) and older (50 years and older) females.

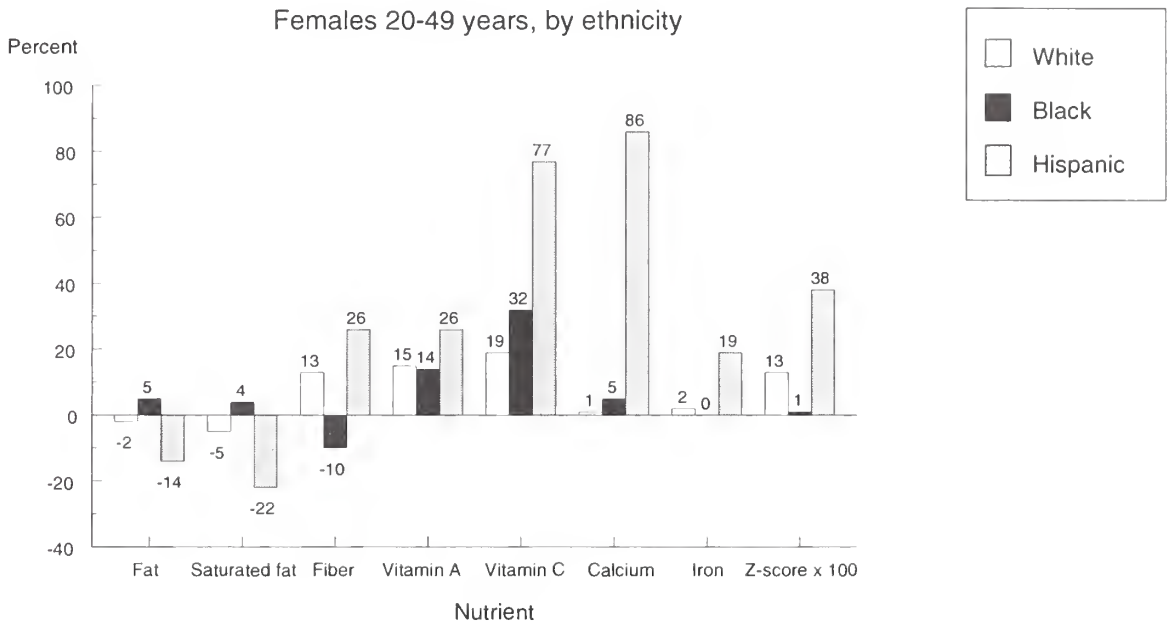
The F-statistics in table 4 reveal that the association between supplement use and many nutrient densities is significantly dependent upon measures of diet-heart knowledge, confusion about dietary recommendations, beliefs about the need to change diet, and attitudes about the importance of food and diet to health. These interactions are especially strong and consistent for the two KAB variables pertaining to "too many recommendations" and "no need to change my diet"

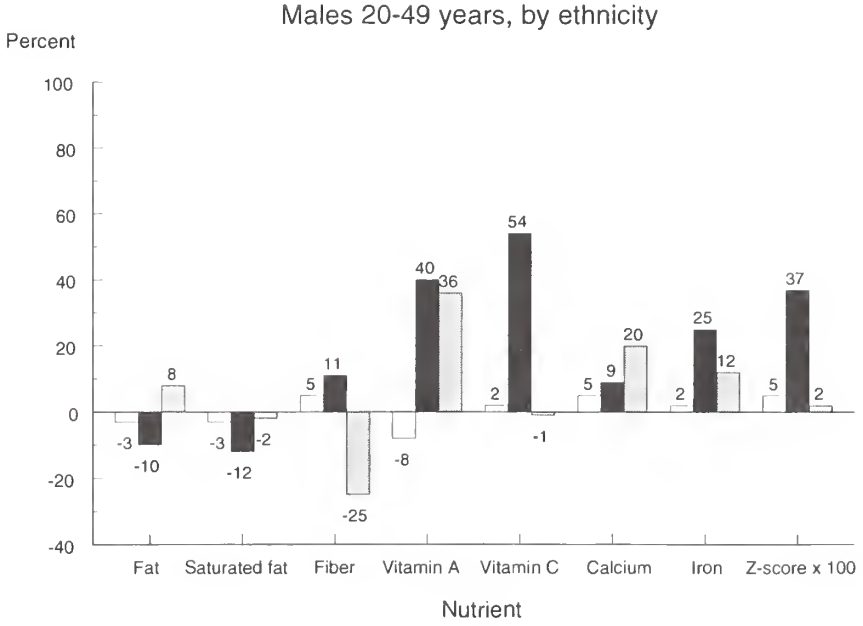
Table 3. Regression coefficients for main effects and interaction terms involving supplement use with ethnicity, age, and sex (N = 7,361)

Variable	Nutrient							Diet score
	Fat	Saturated fat	Fiber	Vitamin A	Vitamin C	Calcium	Iron	
Main effects[1]								
Intercept	35.442	3.521	1.841	5.823	3.331	5.972	1.914	–.135
Supplement users	–.675	–.077	.113	.117	.137	.011	.0176	.111
Black	–.368	–.108	–.071	–.200	.018	–.244	–.059	–.107
Hispanic	–.519	–.087	.007	–.069	.067	–.151	–.044	–.027
Age50	–1.837	–.169	.199	.230	.339	.008	.079	.246
Males	.933	.053	.010	–.057	–.091	–.058	–.017	–.069
Two-way interactions								
Supp x Black	2.190	.139	–.234	–.001	.109	.044	–.028	–.117
Supp x Hispanic	–4.050	–.313	.101	.087	.383	.059	–.016	.250
Supp x Age50	.151	.032	–.058	.101	–.011	.031	.004	–.002
Supp x Males	–.329	.028	–.082	–.218	–.148	.028	–.006	–.079
Three-way interactions								
Supp x Black x Age50	.353	.024	.303	.474	–.103	.012	.169	.203
Supp x His x Age50	8.835	.695	–.267	–.058	–.556	.201	–.100	–.455
Supp x Black x Male	–4.945	–.309	.309	.440	.293	.028	.245	.451
Supp x His x Male	7.800	.333	–.425	.296	–.415	.093	.105	–.277
Supp x Age50 x Male	1.756	.070	.017	.233	–.066	–.051	–.008	–.026
Four-way interactions								
Supp x Black x Age50 x Male	4.434	.266	–.384	–1.271	–.353	.050	–.450	–.653
Supp x His x Age50 x Male	–10.664	–.635	.498	–.452	.468	–.290	–.015	.373
F Statistic for interactions[2]	5.569	5.667	6.160	6.562	3.969	1.243	2.439	5.166
Probability	<0.001	<0.001	<0.001	<0.001	<0.001	NS	<0.01	<0.001

[1]Models also include income, education, and employment status.
[2]F values ≥ 1.95 are significant at $p < 0.05$.
Abbreviations: Supp = supplement users; His = Hispanic; Age50 = 50 years and older.

Figure 1. Percent difference in mean nutrient intake between supplement users and nonusers[1] by ethnicity





[1]Adjusted for income, education, and employment.

Table 4. F-Values for interaction terms involving supplement use with ethnicity and knowledge, attitudes, and beliefs variables[1]

Variable	Nutrient							Diet score
	Fat	Saturated fat	Fiber	Vitamin A	Vitamin C	Calcium	Iron	
Females 20 - 49 years								
Heart health knowledge[2]	6.13***	4.14**	4.17**	2.06	0.30	5.75***	2.21	2.18
Too many recommendations[3]	4.92***	3.63**	3.23*	3.67**	3.80**	8.58***	2.19	5.34**
No need to change[4]	8.50***	4.79***	1.95	2.96*	2.36*	7.95***	1.66	6.87**
Attitudes about nutrition[5]	4.16**	4.15**	1.24	3.63**	5.24***	6.55***	0.88	3.00*
Females 50 years and older								
Heart health knowledge[2]	0.69	0.65	1.69	3.73**	1.73	0.89	3.13*	1.80
Too many recommendations[3]	1.84	0.88	2.70*	4.37**	1.00	0.74	3.34**	2.56*
No need to change[4]	2.57*	1.74	2.34	3.98**	1.48	1.98	3.29*	2.53*
Attitudes about nutrition[5]	0.62	1.08	3.02*	4.69**	1.37	1.19	4.70**	2.45*

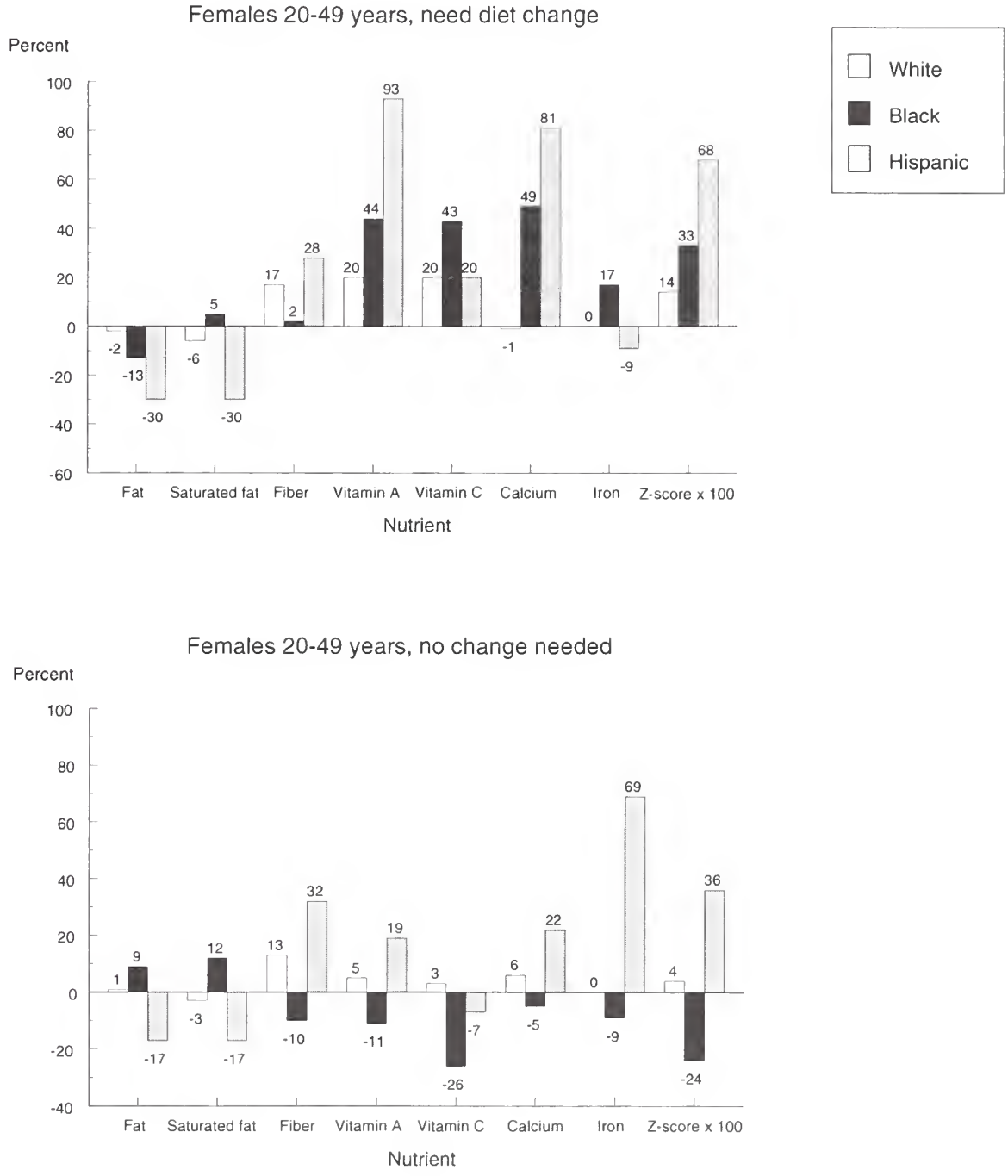
[1]Models also include income, education, employment status, ethnicity, age, and supplement use. The models also include the two-way interactions between supplement use and age, ethnicity, and the KAB variable, as well as the three-way interaction of supp x ethnicity x KAB. The F-values shown here correspond to the R^2 improvement for the entire block of interactions.
[2]Knowledge of diet-heart disease relationships.
[3]Degree of agreement with "There are too many dietary recommendations and it is hard to know what to believe."
[4]Degree of agreement with "Things I eat are healthy so there is no need to change."
[5]Degree to which respondent feels that each of 12 nutrition recommendations is important (salt, fat, saturated fat, cholesterol, five-a-day, sugar, alcohol, fiber, starch, variety, desirable weight, 6 grain servings per day).
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

and are statistically significant ($p<0.05$) in 44 percent of the comparisons for older women (14 out of 32 comparisons) and 72 percent of comparisons for younger women (23 out of 32 comparisons). These results provide strong evidence that the strength and/or direction of the association between supplement use and nutrient densities in food is dependent upon an individual's knowledge, attitudes, and beliefs about diet and health.

To illustrate the implications of these interaction models, figure 2 shows the predicted means pertaining to the "no need to change" model for younger females from the three ethnic groups. This case was chosen for illustration because it has the strongest interaction in table 4 ($F=6.87$ for the mean diet score). The figure shows that among women 20-49 years old who feel that their diet needs to change, supplement use is associated with nutrient profiles that are similar to or more healthful than those for nonusers. The most healthful profiles are seen among Hispanic supplement users, who have 30 percent lower fat and saturated fat intakes and substantially higher vitamin A (93 percent) and calcium (81 percent) intakes compared with nonusers, with a mean diet score that is .68 Z-scores higher than nonusers. Similar healthful patterns are seen among Black and White women, but the differences between users and nonusers are smaller than those seen among Hispanic women.

Among young women who feel that their diet does not need to change (lower panel), the healthful nutrient profile for Hispanics is replicated (though less marked), but the nutrient profile for Blacks is reversed. Specifically, in this comparison, Black supplement users have 9 and 12 percent higher fat and saturated fat densities and 5 to 26 percent lower densities for fiber, vitamins A and C, calcium, and iron, compared with nonusers. The result is a mean diet score that is .24 Z-scores *lower* among users than nonusers. Among Black women who feel that their diet does need to change (upper panel), the mean diet score of supplement users is .33 Z-scores *higher* than that of nonusers.

Figure 2. Percent difference in mean nutrient intake between supplement users and nonusers[1] by no need to change model



[1]Adjusted for income, education, and employment.

Discussion

The purpose of this study is to investigate the association between supplement use and nutrient intake from food in greater detail than in previous studies. The major findings are: (1) the previously reported positive association between supplement use and nutrient densities from food are observed in this sample and are diminished in magnitude—but not eliminated—when controlling for sociodemographic variables (table 2); (2) the direction and strength of this association varies across age, sex, and ethnic groups (table 3); and (3) the direction and strength of this association varies according to the nutrition knowledge, attitudes, and beliefs held by an individual (table 4).

The existence of significant interactions, as documented in this study, calls into question the generalizations reached by most previous studies concerning the positive association between supplement use and nutrient intake. Of the 13 studies examining this relationship and contributing to such generalizations *(4-6,8-11, 13,20-22,25,26)*, only one investigated the possibility of nonuniformity across socioeconomic and ethnic groups. That study *(10)*, based on NHANES II data, reported lower iron intake among Black men who use supplements. It also examined calcium, thiamine, riboflavin, niacin, and vitamin C, all of which showed positive associations with supplement use and some of which were also influenced by significant *supplement x population* group interactions. That study did not examine fat, saturated fat, fiber, vitamin A, or an overall diet score; it did adjust for caloric intake through multiple regression, thereby precluding direct comparison with the present study.

Another earlier study examined possible interactions among food beliefs, supplementation, and food intake *(25)*. That study, based on a sample from Adelaide, Australia, reported that regular supplement users differ significantly in their food beliefs from irregular users and consume significantly more high fat foods, meat products, and takeaways (fastfood) than nonusers or irregular users. The authors' conclusion that supplement users are a heterogeneous group in terms of food beliefs and their reasons for taking supplements were in agreement with conclusions from other studies *(23)*. This is consistent with the findings in the present study: supplement use is positively associated with the quality of food intake in some groups (e.g., among Black females who feel their diet should change) but negatively associated in other groups (e.g., among Black females who feel no need to change their diet).

Nutrition attitudes and beliefs, as assessed in the CSFII, are likely to be part of an entire constellation of cognitive and behavioral characteristics. It could be hypothesized that persons with positive (or healthful) attributes are a highly motivated and health-conscious group in which supplement use is part of a healthy overall lifestyle. Or, users with unhealthful nutrition attitudes and beliefs may be using supplements to compensate for a diet and lifestyle that they perceive to be unhealthful. The present study further suggests that this hypothesis may not apply equally to all age and ethnic groups, as revealed by the significant three-way interactions involving ethnicity.

It bears emphasizing that the main purpose of this study is to test the null hypothesis, implicitly accepted in most previous studies, that there is no significant heterogeneity among major population groups in the relationship between supplement use and nutrient intake from food. The results of interaction analysis are taken as strong evidence *against* the null hypothesis, especially in light of the fact that the measure of nutrient intake is based on a single 24-hour recall and the measure of supplement use is a simple yes/no variable. Both of these methodological characteristics serve to *attenuate* the power to detect statistically significant associations and interactions *(3)*. As such, they could have been invoked to explain *negative* results, had they been found, but they cannot be invoked to explain the presence of the observed interactions.

Although the present study offers evidence against the null hypothesis that the association between supplement use and nutrient intake from food is homogeneous across population groups, the mean intakes for specific population groups and interaction terms for specific groups are assumed to be much less stable and, therefore, have not been emphasized in the interpretation. This is because of substantial variation in sample sizes across population groups and the intrinsic high variability in nutrient intake. Future studies, utilizing surveys with larger sample sizes, should be undertaken to investigate group-specific means in more detail.

In conclusion, this study suggests that supplement use is associated with higher quality diets in some population groups and lower quality diets in others. It appears that the strength and direction of this association relate in part to individual and group-level differences in knowledge, attitudes, and beliefs concerning supplements, food, and health. These findings require confirmation in larger national samples, with particular attention to the frequency of usage and types of supplements being used, and they deserve more detailed qualitative study in specific population groups. Such information could reveal the likely consequences of a permissive policy regarding a supplement-based approach to the prevention of chronic disease, as implied by the 1984 Dietary Supplement Health and Education Act (P.L. 103-417) and a proposal (H.R. 104-236) that would have permitted the use of food stamps to purchase supplements. Such follow-up studies may also indicate the type of health and nutrition education about supplement use that is appropriate for various population groups.

References

1. The Alpha-Tocopherol, Beta Carotene Cancer Prevention Study Group (ATBCCP). 1994. The effect of vitamin E and beta carotene on the incidence of lung cancer and other cancers in male smokers. *New England Journal of Medicine* 330*(15)*:1029-1035.

2. American Dietetic Association. 1987. Recommendations concerning supplement usage: ADA statement. *Journal of the American Dietetic Association* 46:1342-1343.

3. Beaton, G.H., Milner, J., Corey, P., McGuire, V., Cousins, M., Stewart, E., de Ramos, M., Hewitt, D., Grambsch, P.V., Kassim, N., and Little, J.A. 1979. Sources of variance in 24-hour dietary recall data: Implications for nutrition study design and interpretation. *American Journal of Clinical Nutrition* 32:2546-2559.

4. Bowering, J. and Clancy, K.L. 1986. Nutritional status of children and teenagers in relation to vitamin and mineral use. *Journal of the American Dietetic Association* 86*(8)*:1033-1038.

5. Bowerman, S.J.A. and Harrill, I. 1983. Nutrition consumption of individuals taking or not taking nutrient supplements. *Journal of the American Dietetic Association* 83*(3)*:298-305.

6. Breskin, M.W., Trahms, C.M., Worthington-Roberts, B., Labbe, R.F., and Koslowski, B. 1985. Supplement use: Vitamin intakes and biochemical indexes in 40- to 108-month-old children. *Journal of the American Dietetic Association* 85*(1)*:49-56.

7. Flagg, E.W., Coates, R.J., and Greenberg, R.S. 1995. Epidemiologic studies of antioxidants and cancer in humans. *Journal of the American College of Nutrition* 14*(5)*:419-427.

8. Garry, P.J., Goodwin, J.S., Hunt, W.C., Hooper, E.M., and Leonard, A.G. 1982. Nutritional status in a healthy elderly population: Dietary and supplemental intakes. *American Journal of Clinical Nutrition* 36:319-331.

9. Gray, G.F., Paganini-Hill, A., and Ross, R.K. 1983. Dietary intake and nutrient supplement use in a southern California retirement community. *American Journal of Clinical Nutrition* 38:122-128.

10. Koplan, J.P., Annest, J.L., Layde, P.M., and Rubin, G.L. 1986. Nutrient intake and supplementation in the United States (NHANES II). *American Journal of Public Health* 76*(3)*:287-289.

11. Kurinij, N., Klebanoff, M.A., and Graubard, B.I. 1986. Dietary supplement and food intake in women of childbearing age. *Journal of the American Dietetic Association* 86*(11)*:1536-1540.

12. Le Marchand, L., Yoshizawa, C.N., Kolonel, L.N., Hankin, J.H., and Goodman, M.T. 1989. Vegetable consumption and lung cancer risk: A population-based case-control study in Hawaii. *Journal of the National Cancer Institute* 81*(5)*:1158-1164.

13. Looker, A., Sempos, C.T., Johnson, C., and Yetley, E.A. 1988. Vitamin-mineral supplement use: Association with dietary intake and iron status of adults. *Journal of the American Dietetic Association* 88*(7)*:808-814.

14. Millns, H., Woodward, M., and Bolton-Smith, C. 1995. Is it necessary to transform nutrient variables prior to statistical analyses? *American Journal of Epidemiology* 141*(3)*:251-262.

15. National Academy of Sciences, National Research Council, Food and Nutrition Board. 1989. *Diet and Health: Implications for Reducing Chronic Disease Risk.* National Academy Press, Washington, DC.

16. National Cancer Institute. 1996. Beta carotene, vitamin A halted in lung cancer prevention. National Cancer Institute Press Release. U.S. Newswire, January 18, 1996.

17. Porter, D.V. 1995. Dietary Supplement Health and Education Act of 1994: P.L. 103-417. *Nutrition Today* 30*(2)*:89-94.

18. SAS Institute, Inc. 1990. *SAS/STAT User's Guide, Version 6.* SAS Institute, Inc., Cary, NC.

19. Shah, B.V., LaVange, L.M., Barnwell, B.G., Killinger, J.E., and Wheeless, S.C. 1989. SUDAAN. Research Triangle Institute, Research Triangle Park, NC.

20. Shapiro, L.R., Samuels, S., Breslow, L., and Camacho, T. 1983. Patterns of vitamin C intake from food and supplements: Survey of an adult population in Alameda County, California. *American Journal of Public Health* 73*(7)*:773-778.

21. Slesinski, M.J., Subar, A.F., and Wun, L.M. 1995. Intake of nutrients in users of vitamin and mineral supplements: The 1992 National Health Interview Survey. *FASEB Journal* 9*(3)*:A578.

22. Sowers, M.R. and Wallace, R.B. 1986. Contribution of water and diet supplements to nutrient intake. *Journal of the American Dietetic Association* 86*(9)*:1192-1195.

23. Stewart, M.L., McDonald, J.T., Levy, A.S., Schucker, R.E., and Henderson, D.P. 1985. Vitamin/mineral supplement use: A telephone survey of adults in the United States. *Journal of the American Dietetic Association* 85:1585-1590.

24. Subar, A.F. and Block, G. 1990. Use of vitamin and mineral supplements: Demographics and amounts of nutrients consumed. *American Journal of Epidemiology* 132*(6)*:1091-1101.

25. Worsley, A., Crawford, D.A., and Baghurst, K.I. 1987. Diet, food beliefs and dietary supplementation. *Ecology, Food and Nutrition* 19:281-296.

26. Yearick, E.S., Wang, M.L., and Pisias, S.J. 1980. Nutritional status of the elderly: Dietary and biochemical findings. *Journal of Gerontology* 35*(5)*:663-671.

Research Brief

Snacking Habits of Different Income Groups

Shanthy A. Bowman
Center for Nutrition Policy and Promotion

He looked up at his clock, which had stopped at five minutes to eleven some weeks ago. "Nearly eleven o'clock," said Pooh happily. "You're just in time for a little smackerel of something," and he put his head into the cupboard.

— The House at Pooh Corner

Elevenses, tea time, and high-tea are some of the traditional snacking occasions. Today, in America, changing lifestyles have led to a less formal meal pattern schedule, and mealtimes do not always conform to a set time period of the day. Also, the lack of time for a sit-down meal, the prevalence of food vending machines, and the popularity of various types of snack bars have encouraged more individuals to rely on snacks and beverages between meals for their energy intake. In 1995, according to the Snack Food Association *(3)*, the snack industry measured $15.1 billion in retail sales of grain-based snacks, potato chips, nuts, meat snacks, cookies and crackers, and other miscellaneous snacks. Cross *et al. (2)* reported that afternoon was the most popular time for snacking for all age groups, followed by evening. Salty/crunchy snacks were the most consumed snacks in the afternoon. They also found that most snacking occurred at home; therefore, choice of foods as snacks was determined by what was available in the home.

The purpose of this study is to examine the snacking patterns of individuals at different household income levels—choices of foods as snacks, frequency of snacking at different time periods of the day, and contribution of foods and beverages consumed as snacks to the total diet.

Method

Data for the study are from USDA's 1994 Continuing Survey of Food Intakes by Individuals (CSFII). All individuals, except breastfed children, with complete food intake records on day 1 of the survey were grouped by household income. Group 1 (N=1563) had income below 131 percent of the poverty level; group 2 (N=1854) had income between 131 and 299 percent of the poverty level; and group 3 (N=2123) had income at 300 percent of the poverty level and above.

In the 1994 CSFII, the respondents were asked to name the eating occasion for each food and beverage reported consumed. One of the eating occasions was "food and/or beverage break." In this study, "snacks" included all foods and beverages reported as consumed during a "food and/or beverage break," and no attempt was made to reclassify the eating occasion based on the time of consumption. For simplicity, this eating occasion is also called "snack break" throughout the paper. Foods that were eaten at breakfast, lunch, and dinner were not included under snacks.

Table 1. Mean intakes of food groups and food guide servings per individual in a day, by poverty status, 1 day, Continuing Survey of Food Intakes by Individuals, 1994

Food groups	Income level expressed as a percent of poverty					
	Under 131		131-299		300 and over	
	All day[1]	Snacks	All day[1]	Snacks	All day[1]	Snacks
	Grams					
Total grain products	292	40 (13.7%)	291	35 (12.0%)	309	38 (12.3%)
Total fruits	150	36 (24.0%)	162	45 (27.8%)	187	52 (27.8%)
Total milk and milk products	276	65 (23.6%)	274	64 (23.4%)	279	67 (24.0%)
Total sweets	20	9 (45.0%)	26	11 (42.6%)	17	11 (63.6%)
Total beverages	773	196 (25.4%)	917	227 (24.8%)	1,004	301 (30.0%)
	Number of servings					
Grain group	6.06	1.0 (16.7%)	6.30	0.9 (14.3%)	6.97	1.1 (15.8%)
Fruit group	1.30	0.4 (30.1%)	1.51	0.5 (33.3%)	1.81	0.6 (33.3%)
Milk group	1.70	0.4 (23.5%)	1.79	0.4 (22.2%)	1.87	0.4 (21.4%)

[1] "All day" includes foods consumed throughout the day including snacks.
Note: The numbers within the parentheses indicate the percent contribution of snacks to the day's total.

The analysis included 1,376 individuals who did not report a food and/or beverage break. Mean intakes of foods, nutrients, Food Guide Pyramid servings, and frequency of snacking were computed using the SPSS-X (Release 6.1) software package. Day 1 full sample weights were used in the analysis.

Results

On average, 75 percent of Americans reported having a snack or beverage break. The percentage of individuals having a snack or beverage break increased with an increase in income: 69 percent in Group 1, 74 percent in Group 2, and 79 percent in Group 3.

What do people eat for snacks?

The mean intakes of food groups and food group servings are shown in table 1. All income groups consumed about the same amount of fluid milk as snacks, but Group 1 drank at least twice as much whole milk as did Groups 2 or 3. A higher proportion of skim milk was consumed by Group 3 than by the other two Groups. Among fresh fruits, apples were consumed most by all three groups, followed by bananas and oranges. Watermelon, grapes, peaches, pears, nectarines, and mangoes were some of the other fruits consumed as snacks. Orange, apple, and grape juices were the fruit juices of choice for all three groups. There were differences among the three groups in the choices of grain products as snacks.

The most consumed grain products for Group 1 were white bread, pizza, pasta, macaroni with cheese, and noodle soups; for Group 2, white bread, apple pies, and corn-based salty snacks; and for Group 3, hard pretzels, corn-based salty snacks, chocolate chip cookies, and spaghetti. The contribution of snacks to the day's vegetable intake was very small (3 to 8 percent). Potato chips were the most consumed food from the vegetable group, and beer was the most consumed alcoholic beverage by all income groups.

The mean consumption of some food subgroups—grain-based salty snacks, fruits and fruit juices, yogurt, carbonated soft drinks, coffee, tea, alcoholic beverages, and candies—increased with an increase in income (table 2). In contrast, fried potatoes (includes chips) and whole milk decreased as income level increased.

Table 2. Mean intakes of food subgroups as snacks, per individual in a day, by poverty status, 1 day, Continuing Survey of Food Intakes by Individuals, 1994

Foods	Income level expressed as a percent of poverty		
	Under 131	131-299	300 and over
		Grams	
Grain-based salty snacks	4.8	5.3	8.8
Fried potatoes (includes chips)	3.2	1.9	1.4
Citrus fruits and juices	9.0	12.2	14.1
Noncitrus fruits and juices	25.7	32.2	36.5
Whole milk	26.4	13.3	9.6
Lowfat milk	12.2	19.7	15.6
Skim milk	1.4	2.4	9.3
Cheese	2.4	2.4	3.0
Yogurt	1.2	2.0	3.0
Dairy desserts	11.7	14.3	19.9
Carbonated soft drinks	73.5	101.3	110.4
Coffee	22.7	31.1	52.0
Tea	14.1	18.2	31.4
Fruit drinks and ades	33.0	22.0	22.4
Alcoholic beverages	52.5	54.4	84.9
Candies	4.8	5.2	6.1
Cakes, cookies, and pies	12.8	16.4	15.5

Percentages of individuals who consumed some of the foods and beverages as snacks are shown in table 3. Similar proportions of individuals from all income groups consumed milk for snacks. A higher percentage of the low income group had fried potatoes and fruit drinks and ades than did the other two groups. For other food groups, the percentage of individuals consuming a food group as a snack increased with an increase in income.

What are the popular snacking times and snacks consumed?

Percent distributions of snacking occasions for all individuals and by poverty status are shown in table 4. Individuals snacked more often in the afternoon and in the evening. The lowest income group was more likely than the other two income groups to report snacking between noon and 2 p.m., which may be considered lunch time, and between 4 and 8 p.m., which may be considered supper or dinner time. Interestingly, the highest income group had the lowest snacking frequencies between noon and 2 p.m. It is possible that these individuals were better able to afford a bigger meal—lunch—than could the other two groups.

Consumption of snacks and beverages, including alcoholic beverages, was the highest between 8 and 10 p.m. Most frequently consumed snacks during this period were cakes, cookies, and pies (12 percent), dairy desserts (9 percent), grain-based salty snacks (8 percent), noncitrus fruits and juice (8 percent), fluid milk (8 percent), soft drinks (8 percent), coffee and tea (5 percent), and alcoholic beverages (4 percent). Cakes, cookies, and pies (11 percent), noncitrus fruits and juices (10 percent), grain-based salty snacks (8 percent), and carbonated beverages (13 percent) were the preferred snacks between 2 and 4 p.m.

Between 6 and 8 a.m., coffee (31 percent), milk (11 percent), and tea (6 percent) were the main beverages consumed as snacks. Between 8 and 10 a.m., individuals mostly had coffee (19 percent), fruits and fruit juices (9 percent), milk (7 percent), carbonated beverages (8 percent) and cakes, cookies, and pies (11 percent).

What are the popular times for snacking?

Fluid milk was most frequently consumed as a snack from 8 to 10 p.m. (30 percent), followed by 10 to 12 p.m. The most common time to snack on all fruits and fruit juices was also from 8 to 10 p.m. (20 percent), followed by the 2 to 4 p.m. period; for candies—between 2 to 4 p.m., followed by 8 to 10 p.m.; for alcoholic beverages—from 8 to 10 p.m. (26 percent), followed by 10 to 12 p.m. (21 percent) and then by 4 to 6 p.m. (18 percent). Coffee was consumed as part of a beverage break, in the morning from 6 o'clock to noon (41 percent) or in the night between 8 and 10 (19 percent). Unlike coffee, tea was more often consumed as part of a beverage break in the afternoon than before noon—2 to 6 p.m. (23 percent) and 8 to 10 p.m. (24 percent). Carbonated beverages were most frequently consumed between 2 and 4 p.m. (20 percent), followed by 8 to 10 p.m. (19 percent).

One-fourth of the cakes, cookies, and pies; and grain-based salty snacks, and one-sixth of fried potatoes were consumed between 8 and 10 p.m.—a time period when alcoholic beverage consumption was also at the highest level. Most intakes of dairy desserts were in the evening—about one-half between 8 and 10 p.m. and about one-sixth each between 6 and 8 p.m. and 10 p.m. and midnight.

What is the contribution of snacks to food group and nutrients intake?

Snacks provided about 14 to 17 percent of grain group servings, 21 to 24 percent of milk group servings, and 30 to 33 percent of fruit group servings for the day. About one-fourth of the day's total beverages (includes coffee, tea, soft drinks, fruit drinks, fruit ades, and alcoholic beverages, and excludes milk and fruit juices) were consumed during a snack or beverage break. Snacks also provided 17 and 19 percent of total calories (table 5), about one-fifth of carbohydrates, about one-tenth of protein, and between 15 and 19 percent of fat, saturated fat, fiber, vitamin C, calcium, and potassium of the day's total. Less than 15 percent of the day's protein, vitamin A, folate, iron, zinc, and sodium came from snacks.

Discussion

In 1994, 75.3 percent of Americans reported snacking or having a beverage break. The percentage of individuals who snacked or had a beverage break increased with an increase in income. A similar finding in a study of breakfast eaters indicated that the percentage of individuals not skipping breakfast increased with an increase in income *(1)*.

Table 3. Percent of individuals that reported having food groups for a snack or beverage break, by poverty status, 1 day, Continuing Survey of Food Intakes by Individuals, 1994

Foods	Income level expressed as a percent of poverty			
	All individuals	Under 131	131-299	300 and over
		Percent		
Grain-based salty snacks	16.6	12.6	15.4	19.1
Cakes, cookies, and pies	22.1	18.3	22.6	23.4
Fried potatoes (includes chips)	4.0	6.2	3.7	3.3
Citrus fruits and juices	5.8	5.1	5.9	6.0
Noncitrus fruits and juices	15.5	12.5	14.5	17.3
Fluid milk	13.0	13.0	12.9	13.2
Dairy desserts	10.9	8.0	9.6	12.9
Carbonated soft drinks	20.8	19.8	20.2	23.1
Coffee	9.6	6.3	7.9	12.1
Tea	6.0	3.8	5.1	7.5
Fruit drinks and ades	6.7	8.2	6.2	6.4
Alcoholic beverages	6.8	3.3	5.7	9.0
Candies	12.7	10.8	12.4	13.7

Table 4. Percent distribution of snacking occasions, at different time intervals, by poverty status, 1 day, Continuing Survey of Food Intakes by Individuals, 1994

Time intervals	Income level expressed as a percent of poverty			
	All individuals	0-131	131-299	300 and over
		Percent		
Midnight - 6 a.m.	3.4	3.5	3.1	3.6
6 a.m. - 8 a.m.	1.9	1.2	2.2	2.0
8 a.m. - 10 a.m.	4.8	3.4	4.2	5.5
10 a.m. - noon[1]	9.1	7.3	10.3	9.0
12 p.m. - 2 p.m.	6.0	7.6	7.2	4.9
2 p.m. - 4 p.m.	15.2	14.2	15.4	15.4
4 p.m. - 6 p.m.	12.9	15.7	11.7	12.6
6 p.m. - 8 p.m.	10.8	12.1	10.4	10.7
8 p.m. - 10 p.m.	22.8	20.9	22.8	23.5
10 p.m. - midnight[2]	12.5	13.2	12.2	12.5
Indeterminate	0.6	0.9	0.5	0.3

[1]Noon - 12 p.m.
[2]Midnight - 12 a.m.

Table 5. Mean intakes of energy and nutrients per individual in a day, by poverty status, 1 day, Continuing Survey of Food Intakes by Individuals, 1994

Food groups	Income level expressed as a percent of poverty					
	Under 131		131-299		300 and over	
	All day[1]	Snacks	All day[1]	Snacks	All day[1]	Snacks
Energy (kcal)	1,861	353	1,960	344	2,053	388
Protein (g)	72.3	8.4	74.4	7.4	77.7	8.4
Total fat (g)	70.9	12.3	73.2	11.2	76.2	12.0
Saturated fat (g)	25.0	4.6	25.2	4.2	25.8	4.4
Carbohydrate (g)	230.8	49.6	249.6	51.5	260.4	57.9
Dietary fiber (g)	13.0	2.1	14.7	2.1	16.1	2.6
Cholesterol (mg)	277	25	257	21	249	23
Vitamin A (IU)	5,088	581	5,804	578	7,092	688
Vitamin C (mg)	96	17	94	15	104	17
Folate (µg)	229	31	253.7	33	274.8	39
Calcium (mg)	756	140	787	140	822	149
Iron (mg)	13.5	2	14.8	2	15.9	2
Zinc (mg)	10.1	1	11.1	1	11.3	1
Sodium (mg)	3,090	382	3,207	331	3,375	382
Potassium (mg)	2,357	368	2,541	361	2,771	422

[1]"All day" includes foods consumed throughout the day including snacks.

The mean intakes of fruits, grain-based snacks, dairy desserts, carbonated beverages, coffee, tea, and alcoholic beverages increased with income. The lower income groups were more likely to have high-fat products such as fried potatoes including potato chips, and higher sugar fruit drinks and ades for snacks. There were no differences among the three income groups in the choices of fruits and beverages for snacks. However, the choices of grain-based snacks differed among the groups. Low-income individuals ate pizza, soups, and sandwiches for snacks, which may imply that they snack on leftovers.

Snacks provided about one-fifth of the day's milk servings, about one-third of the day's fruit servings, and about one-seventh of the day's grain servings. The contribution of snacks to the vegetable and the meat groups was negligible. Snacks supplied a little less than one-fifth of total calories but less than one-sixth of many nutrients for the day. Therefore, snacking is not a nutrient dense eating occasion. Consuming vegetables, whole grain products, and/or fruits and fruit juices as snacks will improve the quality of the overall diet for the day.

Most snacking occurred in the afternoons and later in the evening—the highest frequency of snacking was between 8 and 10 p.m. The lowest income group snacked more than the other income groups during the conventional lunch and dinner hours. This could reflect an inability to afford a nutritionally adequate meal.

References

1. Bowman, S.A. 1997. Role of breakfast in the American diet by income group. *Family Economics and Nutrition Review* 10*(3)*:50-54.

2. Cross, A.T., Babicz, D., and Cushman, L. 1994. Snacking patterns among 1,800 adults and children. *Journal of the American Dietetic Association* 94*(12)*: 1398-1403.

3. The Snack Food Association. 1997 (August 4). Home page, http://www.usii.net/sfa/sfahome.htm

Would you like to publish in *Family Economics and Nutrition Review?*

Family Economics and Nutrition Review will consider for publication articles concerning economic and nutritional issues related to the health and well-being of families. We are especially interested in studies about U.S. population groups at risk—from either an economic or nutritional perspective. Research may be based on primary or secondary data as long as it is national or regional in scope or of national policy interest, and articles may use descriptive or econometric techniques.

Family Economics and Nutrition Review has a new feature that we call Research Briefs. We define Research Briefs as short research articles. In general, our Guidelines for Authors apply (see back inside cover)—with the following exceptions:

#4—No abstract is required.
#5—Text, references, tables, and figures should not exceed 10 pages.

We invite submission of Research Briefs; manuscripts may contain findings previously presented at poster sessions if not published in proceedings (except for abstract).

Manuscripts may be mailed to: Jane Fleming, Managing Editor, *Family Economics and Nutrition Review*, Center for Nutrition Policy and Promotion. See guidelines on back inside cover for complete address.

Expenditures on Necessities by the Elderly and Nonelderly During the 1980's

Policy issues affecting the elderly population in the United States include changes in health care and Social Security, Federal budget deficits, and intergenerational transfers. As the population aged 65 years and older continued to grow throughout the 1980's, real social welfare expenditures under public programs grew more slowly.

This study was undertaken to ascertain whether elderly households spent proportionately more on necessities in 1990 than in 1980 and to compare elderly and nonelderly households in both years. Because poorer households have minimal spending discretion, the measures of economic welfare used are real income and the share of total household expenditures on food, housing, and health care.

Previous Research

The well-being of many elderly Americans has improved substantially in recent years, due in large part to government transfer programs: Social Security, medicare, supplemental security income (SSI), food stamps, subsidized housing, and (to a lesser extent) Aid to Families with Dependent Children (AFDC), and medicaid. Still, the income distribution of older U.S. households reveals greater inequality than that of younger households.

One study reported significant differences in expenditure patterns between Americans aged 65 to 74 and those 75 years and older. Another study of those ages 65 to 74 and 75 years and older found decreases in expenditure shares for food and housing but increases in expenditure shares for health care between 1980 and 1990.

Research has also demonstrated that—when the level of income is held constant—elderly households spend less than younger ones; the oldest of the elderly households have the lowest average propensity to consume; and the elderly reduce consumption in order to avoid spending down their wealth.[1]

Comparing the spending patterns of the elderly and nonelderly, researchers found that the elderly spend larger shares of their total expenditures on necessities (housing, health care, and food). Studies that compared expenditures of the retired and nonretired reached a similar conclusion: the retired spend significantly larger shares of total expenditures on housing, food at home, and health care and lesser shares on transportation and food away from home.

Data and Methodology

Cross-sectional data from the Consumer Expenditure (CE) Survey Interview tapes for 1980-81 and 1989-90 were used for this study. These tapes contain data on demographics, expenditures, income, taxes, selected assets, housing ownership, and public assistance for each household. The CE Survey Interview sample is a rotating panel that targets

[1]Households headed by a person age 65 to 74 spend only 72 percent of the average expenditures for all households; households headed by someone age 75 years and older spend just 51 percent of that average.

Mean income, total expenditures, and means and shares of expenditures of nonelderly and elderly households, by expenditure category and financial assistance status (in constant 1990 dollars)

Expenditure category	Households not receiving financial assistance[1]				Households receiving financial assistance[1]			
	Nonelderly		Elderly		Nonelderly		Elderly	
	1980-81	1989-90	1980-81	1989-90	1980-81	1989-90	1980-81	1989-90
Mean income								
Before taxes	$30,427	$37,263	$15,537	$20,438	$14,137	$15,147	$6,856	$9,685
After taxes	26,520	33,519	15,071	19,432	13,451	14,613	6,832	9,578
Total expenditures	25,883	31,468	15,071	19,432	13,579	15,879	7,542	9,242
Mean dollar amount								
Food	4,870	4,800	3,160	3,391	3,675	3,723	2,355	2,300
Housing	7,158	9,528	4,849	5,937	4,394	5,375	2,640	3,609
Health	968	1,236	1,548	2,190	319	474	544	762
Other	12,887	15,904	5,514	7,914	5,191	6,299	2,003	2,571
Share of budget (percentage)								
Food	18.8	15.3	21.0	17.5	27.1	23.5	31.2	24.9
Housing	27.7	30.3	32.2	30.6	32.4	33.9	35.0	39.0
Health	3.7	3.9	10.3	11.3	2.3	3.0	7.2	8.2
Other	49.8	50.5	36.6	40.7	38.2	39.7	26.6	27.8

[1]Financial assistance includes Aid to Families with Dependent Children (AFDC) and Supplemental Security Income (SSI).

Source: Rubin, R.M. and Koelin, K.,1996, Elderly and nonelderly expenditures on necessities in the 1980s, Monthly Labor Review 119(9):24-31.

5,000 consumer units quarterly, with four quarters of data collected on each and about 1,250 new consumer units cycled into (and out of) the survey each quarter. Although some researchers use each quarter of data as an independent sample, this study includes only households with at least two quarters of data on expenditures.

The sample includes only households that provide values for at least one of the major sources of its income; have before-tax and after-tax income and total expenditures greater than zero; and have positive expenditures for both food and housing. The nonelderly sample excludes households with any person 65 years or older in residence.

Data on income and expenditures for 1980-81 were adjusted for inflation to 1990 levels, using the Consumer Price Index (CPI). The sample was placed in eight groups: elderly and nonelderly households receiving and not receiving cash financial assistance for the two periods. Cash financial assistance is determined by receipt of SSI or AFDC. Recipients of financial assistance have fewer financial assets, less income, and are more frequently non-White, less educated, and less likely to be homeowners. Among the elderly, recipients are more likely to be single; among the nonelderly, they are more likely to be single-parent households.

Mean expenditures and budget shares on necessities were compared across time by age group. Also, the relationships between the dependent variables (expenditures on three categories of necessities) and the explanatory socioeconomic variables were analyzed.

Findings

Because real income, in constant 1990 dollars, increased substantially for all household groups except nonelderly recipients of financial assistance, it was expected that mean expenditures on each category of necessity would increase. It was also expected that a portion of the increase in real income would be allocated to discretionary spending—"other" (defined as total expenditures less expenditures on food, housing, and medical care). These results were confirmed by the data (see table) except that food expenditures decreased for elderly recipients of assistance and nonelderly nonrecipients. A possible explanation is the fact that food prices increased less rapidly over the period than did the overall CPI. The share of the household budget spent on food decreased substantially between 1980-81 and 1989-90 for all four groups.

The elderly spent a slightly larger share of total expenditures on housing than did the nonelderly. Elderly recipients of financial assistance, the group with the lowest income, spent the largest budget share of any group on housing—35 percent in 1980-81 and 39 percent in 1989-90.

Constant-dollar expenditures on health care increased over the decade for each of the groups, indicating more health care purchased or the high inflation rate (96.4 percent for health care vs. 43.8 percent for the overall CPI). As expected, the budget share spent on health care by the elderly was substantially higher than that spent by the nonelderly—in both periods and for both recipients of financial assistance and nonrecipients.

The data indicate that all household groups were better off in 1989-90 than they were in 1980-81, as measured by the amount and share of total expenditures on nonnecessities ("other"). However, smaller gains were made by recipients of financial assistance than by those who did not receive such assistance.

Savings (after-tax income minus total expenditures) were negative in both periods for nonelderly households who received assistance and for elderly households who did not receive assistance. Also, savings were negative for elderly recipients of cash aid in 1980-81 but not in 1989-90. Nonelderly households not receiving financial aid were net savers in both periods.

Estimates of the income elasticity of food, housing, and medical care were determined using the permanent income parameter based on total expenditures. These estimates indicate the percent change in spending on a particular good caused by a 1-percent change in income. Income-elastic expenditures (permanent income parameter greater than 1) are those that increase with income and for which the share of income spent on the expenditure in question increases as income increases. In contrast, income-inelastic expenditures (permanent income parameter less than 1) are those for which the share of income spent on the item in question decreases as income increases, even though expenditures on the item increase with income.

For food, the permanent income parameter was highly significant and positive, but less than 1, for both age groups. This is consistent with economic theory regarding expenditures on necessities—spending on the good increases as income increases—but are income inelastic.

For housing, the permanent income parameter was much closer to 1 for both age groups, indicating housing is less of a necessity than food. For medical care, the permanent income parameter for the nonelderly is much greater than 1, indicating that this category of expenditures is a nonnecessity; however, for the elderly, it is considerably below 1, consistent with the economic definition of a necessity.

Financial assistance was not an important determinant of spending on food for the nonelderly in 1980-81, but it became important by the end of the decade. For the elderly, receipt of assistance was significant and positive in both periods.

For the nonelderly, receiving cash assistance was positive and significant for housing expenditures; however, this effect weakened during the decade. For elderly households, financial assistance had no significant effect on housing expenditures—perhaps reflecting the higher level of home ownership among elderly financial aid recipients compared with nonelderly recipients.

For both elderly and nonelderly households, financial assistance had a significant and negative effect on spending for health care in 1980-81 and in 1989-90. Thus, those with financial assistance spend less on health care than those who are not recipients, probably reflecting the mandatory medicaid coverage for those on AFDC and for most elderly, blind, or disabled recipients of SSI.

These results indicate that, for the population as a whole, well-being increased over the 1980's as measured by both real income and discretionary spending. Well-being increased more for elderly households than for nonelderly households and less for recipients of cash assistance than for those who did not receive assistance.

Source: Rubin, R.M. and Koelin, K., 1996, Elderly and nonelderly expenditures on necessities in the 1980s, *Monthly Labor Review* 119(9):24-31.

Price and Income Affect Nutrients Consumed From Meats

Trends in meat and poultry consumption reflect not only the health concerns of consumers, such as the link between high levels of saturated fat and cholesterol and increased risk of heart disease, but also the effect of economic factors, such as meat prices and consumers' incomes. The U.S.Department of Agriculture's Economic Research Service (ERS) estimates that expenditures on red meat and poultry products account for about one-third of the food spending in American households. Therefore, changes in meat prices or consumers' incomes may not only affect meat purchases but other food purchases as well.

For instance, if beef prices rise while chicken prices remain lower than beef, consumers will likely purchase more chicken than beef. If consumers buy less beef—for example, hamburger meat—they might also buy less cheese and fewer hamburger rolls because of their complementary uses. On the other hand, they could substitute foods or ingredients served with chicken (e.g., barbecue sauce). As a result, changes in food prices could translate into changes in nutrients available for consumption.

Data

To link food quantities and prices, this study used aggregate data from the ERS food disappearance series, which measure supplies moving through U.S. marketing channels for domestic consumption. The nutrient value of each of the three meats used in this study—beef, pork, and chicken—is calculated by USDA's Agricultural Research Service. For this study, lean and fatty cuts of meat are not differentiated; beef, pork, and chicken are each considered a single good, with one price, and one nutrient profile.

Meat Consumption in the American Diet

Over the last two decades, poultry consumption has increased while red meat consumption has decreased. Americans consumed 90 percent more chicken in 1990-94 than in 1970-74, 21 percent less beef, and about the same percentage of pork (table 1). These changes in consumption are partly due to changing relative prices of the various meat products. Over the last 20 years, beef prices have increased 257 percent; pork prices, 252 percent; and chicken prices, 220 percent. Hence, the price of chicken relative to beef dropped by 14 percent between 1970-74 and 1990-94.

Also, chicken has likely benefited from consumer health concerns regarding fat in the diet. In addition, chicken is now offered in more convenient forms, such as processed chicken products and precooked chicken.

Preliminary data show that beef consumption rose slightly in 1995 and 1996 due to larger supplies and lower prices. In spite of concerns regarding diet and health, this recent increase of beef consumption indicates that prices remain an important factor in food selection for Americans.

On average, beef, pork, and chicken contributed about 34 percent of total protein available in the U.S. food supply in 1990-94 (table 2). These meats provided 29 percent of total fat and 35 percent of available cholesterol. The percentage of cholesterol from chicken (14 percent) is slightly higher than that from beef (12 percent) because chicken consumption is higher.

Relationship Between Meat Prices, Income, and Nutrients Consumed

Table 3 shows the percentage change of eight selected nutrients in response to a 10-percent increase in meat prices or income. Most estimated nutrient effects are small; the 10-percent increase in meat prices produces small changes in food quantities. Also, offsetting changes in nutrient intakes between complementary foods and substitute foods minimizes

Table 1. Consumption of chicken overtakes beef

Period	Beef	Pork	Chicken
		Pounds	
1970-74	84	54	40
1975-79	88	47	43
1980-84	78	52	52
1985-89	75	51	62
1990-94	66	51	76

Source: Huang, K.S., 1996, Price and income affect nutrients consumed from meats, FoodReview 19(1):37-40.

Table 2. Share of nutrients in the food supply contributed by meats, 1990-94

Nutrient	Beef	Pork	Chicken	Other foods[1]
		Percent		
Energy	6.5	6.5	4.4	82.6
Protein	13.0	8.0	12.7	66.3
Fat	10.9	12.2	6.2	70.6
Cholesterol	12.1	9.1	13.5	65.4
Iron	8.2	2.4	5.4	84.1
Vitamin A	0	.1	12.3	87.6
Thiamin	2.4	14.2	1.8	81.6
Niacin	9.9	8.3	17.2	64.6

[1]Other foods include 32 other food groups.
Source: Huang, K.S., 1996, Price and income affect nutrients consumed from meats, FoodReview 19(1):37-40.

Table 3. Price and income affect nutrients consumed

Nutrient	Increase meat prices by 10 percent			Increase income by 10 percent
	Beef	Pork	Chicken	
	Percent change in nutrient intake			
Energy	-0.27	-0.11	-0.03	2.66
Protein	-.91	-.28	-.30	2.77
Fat	-.25	-.20	-.09	3.88
Cholesterol	-.25	-.31	-.21	3.06
Iron	-.96	0	0	2.17
Vitamin A	.64	-.04	.61	3.44
Thiamin	-.41	-.99	.15	2.57
Niacin	-.72	-.31	-.48	2.29

Source: Huang, K.S., 1996, Price and income affect nutrients consumed from meats, FoodReview 19(1):37-40.

estimated nutrient effects. A 10-percent increase in beef prices would reduce beef consumption by 6.2 percent and cause changes in the mix of all food purchased. Per capita protein intake would be reduced by 0.91 percent, iron by 0.96 percent, and niacin by 0.72 percent, but vitamin A intake would be higher—by 0.64 percent. A 10-percent rise in pork prices would, on average, produce smaller nutrient reductions than beef price increases, with the exception of thiamin, which would decline by 0.99 percent. A 10-percent price rise for chicken would produce smaller nutrient changes than beef price increases for all eight nutrients.

The quantity of nutrients consumed will increase when consumers' incomes increase. When consumers' incomes go up so do their purchases of more expensive foods, such as meats. An ERS food demand study found that a 10-percent increase in per capita income would increase consumption of beef, pork, and chicken by 3.9, 6.6, and 0.8 percent, respectively. In addition, a 10-percent increase in per capita income would increase energy intake by 2.66 percent, protein by 2.77 percent, fat by 3.88 percent, and iron by 2.17 percent (table 3).

Implications

Changes in the eight nutrient availabilities calculated by ERS vary, depending on how meat prices and income changes manifest themselves through interdependent food demand relationships. However, the disappearance data used in this analysis do not distinguish nutritive values based on different food preparation methods. For example, fried chicken has different nutritional properties than roast chicken.

Nutrient responses to meat prices and income changes, along with other ERS estimates representing a total consumer nutrient profile, are useful in developing a model for studying food program effects on the quality of consumer diets. For instance, these nutrient income responses can be helpful in evaluating the effects of income changes on dietary quality when food stamp recipients' benefits are increased or decreased.

Source: Huang, K.S., 1996, Price and income affect nutrients consumed from meats, *FoodReview* 19*(1)*:37-40.

Making Payments on the Internet

The Internet is a network of computers that use a common method of communication. The Internet is used to send mail, transfer files, and—through the World Wide Web—transmit graphics and sound. In the 15 months between October 1994 and January 1996, the number of computers linked to the Internet is estimated to have increased from 3.9 to 9.5 million.

This widespread form of communication and information transmission has made it possible to imagine continuous, worldwide electronic commerce. On the Internet, a person can comparison-shop, read warranties, establish accounts, view images of products, and order goods and services from companies located anywhere in the world. Home shopping could reduce the transaction costs of shopping significantly. First, however, a way must be devised for buyers and sellers to securely and conveniently exchange payment over the Internet. Information needs to be recognized as authentic but secure from theft.

When e-mail is sent over the Internet, information is transmitted on undedicated telecommunication lines—unlike telephone calls that each require a dedicated line. Thus, Internet messages are routed through other computers before reaching the intended receiver. Messages can be intercepted, read, and changed. Dishonest individuals can send false messages, establish untraceable computer accounts, and collect credit card numbers and payment-related information.

Insuring Privacy and Authenticity

Software companies and financial institutions are developing methods that will allow people to place orders and pay on the Internet. Authenticating messages and preventing eavesdropping are important for both parties to a transaction. The real possibility of theft of information precludes the use of unencrypted credit cards over the Internet, thus secret coding of information is probably necessary to approach the levels of security that people now enjoy with cash, checks, and routine credit card payments.

With traditional encryption methods, the sender and receiver have to share a common key to successfully encrypt and decrypt a message. Therefore, the sender has to give the key to the receiver in some way, making it easier to steal as it is shared with various parties. Once someone has stolen the key, messages can be both decoded and encoded; the criminal can pose as the legitimate party to the encryption system, and no one could detect the deception.

Two American mathematicians (Whitfield Diffie and Martin Hellman) recognized that systems of coding could use a pair of keys—one to encrypt the message (the "public" key) and another to decrypt it (the "private key"). The encrypting key need not be kept secret to ensure a private message and the decrypting key need never be shared with anyone else. This means it is much less susceptible to theft (see box). Applications of this type of cryptology can be used to verify identity (by using a digital signature), authenticate messages, and provide a record of when a transaction occurred.

Approaches to Internet Payments

Several methods of payment on the Internet have been devised. The "trusted third party" method of payment is one where a customer authorizes a third party to make payments on the customer's behalf. The customer supplies (over the telephone or through the mail) the trusted third party with a credit card number or a voided check and written authorization to effect payment. The customer is given a password to use when ordering a product over the Internet. The seller reports the password to the trusted third party who sends the customer a report of the transaction for confirmation. Once confirmed, the trusted third party conveys the payment information electronically. This system avoids the problems of eavesdropping and theft of credit card or checking account information. However, it requires sellers to accept payment in this manner; and so, widespread use may develop slowly.

"Digital cash" is a system that uses software available to participating financial institutions, their customers, and merchants. The customer creates digital messages that are sent to the issuing institution to be authenticated. The authenticated message is returned to the customer and substitutes as digital cash that can be transferred to merchants. Merchants who receive the digital cash can send it on to their banks and have their accounts credited. Counterfeiting is prevented by the issuer's digital signature on the digital cash. Double spending of the cash is prevented by identifying serial numbers and by replacing the cash each time it is spent. An important advantage to digital cash is anonymity. The merchant need not know who is spending the digital cash it receives because the cash is authenticated by the bank, not the customer.

Dual Key Encryption—An Example

Alice obtains Bob's public encryption key, uses it to encrypt a message to Bob, and sends the message to him. Bob can then decrypt the message using his private key. Only someone who has Bob's private key can decrypt messages encoded with his public key. To reply, Bob obtains Alice's public key, encrypts a message, and sends it to Alice. She deciphers the message using her private key.

Alice, in sending a message to Bob, appends her signature to the message, and she encrypts her signature by means of her private key (usually used for decrypting a message). She then uses Bob's public key to encrypt this "signature" and sends it on to Bob. Bob uses his private key to decrypt the message and, seeing a potential signature of Alice, uses her public key to decrypt it. Upon successful decryption, Bob realizes that only Alice could have sent the message because only she has the private key counterpart to her public key. Hence, the digital signature has authenticated the message Alice sent to Bob.

Visa International, MasterCard, and American Express are working together to develop secure electronic transaction (SET) standards to deal with unauthorized intercepting, reading, and sending of fake messages. The standards are based on public key cryptology—credit card numbers will be encrypted. Prior to the transaction, either the bank that issues the card (in the case of the cardholder) or the merchant's bank that processes the transaction will provide both parties with "digital certificates." These certificates bear the digital signature of Visa or MasterCard or some certifying authority. The merchant will not be able to decrypt the holder's card number—authorization from the merchant's bank will ensure payment.

A bank that exists primarily for banking on the Internet has only a small physical office with a "virtual" branch on the Internet. This bank allows customers to pay bills by writing checks or making an electronic payment. Thus, this method is a variation of the trusted-third-party method because information flows through private interbank networks. The Financial Services Technology Consortium (a group of banks and technology companies) is sponsoring research on electronic commerce over open networks, such as the Internet. One project is to create an electronic check that will rely on encryption to secure account numbers and digital signatures to verify identities. It will provide access to one's bank account, rather than create digital cash.

Acceptance and Public Policy Considerations

Although it is too early to evaluate the usefulness and cost-effectiveness of these new means of payment, the diversity of approaches can serve different uses and users. Whereas credit cards are convenient for many retail and mail-order transactions, only merchants who are signed-up customers of the banks' credit card services will accept them. Because there is less "float" time with digital cash, many customers would prefer the credit card method. However, digital cash may be useful for paying small amounts. Digital cash and the trusted-third-party method of payment are often preferred if anonymity is desired or if customers wish to withhold their identity to avoid the merchant using information for marketing purposes.

Regulators and lawmakers need to address issues of consumer protection, disclosure and assignment of participant liability, and privacy. Requiring disclosure of liability can help inform participants about their responsibilities. In the event of a repudiation of a transaction by a customer when a digital signature was used, liability is currently unclear. The Federal Government has chosen a standard for digital signatures that is different from the standard that has emerged in private industry—but neither has the force of the law behind it.

Other issues that must be resolved include:

- Who should be allowed to be a certifying authority for the public key used to create digital signatures? Certification may carry an implicit guarantee of performance—subjecting the certifying authority to considerable risk.
- Digital cash must be backed with some currency; need it be dollar for dollar? Or should digital cash be covered by deposit insurance?
- May software containing sophisticated encryption systems be exported?

Enhancements to consumer privacy laws may be needed to preclude the misuse of consumer information by nonfinancial firms that may offer payment services or affiliated software. The merits of a completely anonymous payment system versus the merits of lower cost, more conventional systems of credit card and electronic checks that allow merchants, banks, and system operators to maintain data bases of user information are being debated.

Source: McAndrews, J. J., 1997, Making payments on the Internet, *Business Review*, January-February, pp. 3-14.

Farmers' Markets: A Survey

Farmers' markets play a vital role in allowing small- to medium-sized growers to gain access to consumers. Without this access, many small farmers would not be able to sell their production, and their farming existence could be threatened. Farmers' markets also provide consumers with a unique experience—a pleasant shopping environment and the opportunity to meet the people who grow their food.

Within the U.S. Department of Agriculture (USDA), the Agricultural Marketing Service's Wholesale and Alternative Markets Program compiled a National Directory of Farmers' Markets in 1994 and again in 1996. Only those markets listed as active by State departments of agriculture were included. The 1996 directory showed a 37-percent increase—from 1,755 markets to 2,410. In addition, there are many markets formed by informal agricultural groups, public service organizations, or religious institutions that can be found throughout the United States.

During September 1994, the USDA sent 1,755 surveys to farmers' markets listed in the 1994 directory; 772 usable responses were obtained. The purpose of the survey was to measure farmer and consumer participation at those farmers' markets that mainly engage in direct sales. Also determined were the number of sales days and the distance traveled to the markets. This report summarizes the results of this survey.

For the survey, "farmers' market" was defined as a common facility or area where several farmers/growers gather on a regular, recurring basis to sell a variety of fresh fruits and vegetables and other farm products directly to consumers.

Data collected from the survey were classified based on the number of farmers served at individual markets. Categories included markets serving: 1 to 9 farmers, 10 to 19 farmers, 20 to 49 farmers, 50 to 99 farmers, 100 to 500 farmers, and over 500 farmers.

The 772 survey respondents serve 20,496 individual farmers. Not all respondents answered all the survey questions. About 60 percent of the markets responded to a question concerning farmers using farmers' markets as their only sales outlet. Of the 13,473 farmers represented by these markets, almost half are using farmers' markets as their sole outlet. Most (94 percent) markets are open 3 or fewer days a week. Larger markets have more farmers participating 2 or more days a week than do smaller markets. A higher number of markets are open on Saturday, followed by Wednesday, Thursday, Tuesday, and Friday.

Characteristics of farmers' markets in the United States

Size of market, by number of farmers served	Number of markets (772)[1]	Customers per week (627)[1]	Number of farmers (772)[1]	Annual sales per year (382)[1]	Average sales per farmer (382)[1]
1 - 9	184	67,590	1,036	1,973,193	3,607
10 - 19	206	76,158	2,691	3,546,515	2,659
20 - 49	232	278,665	6,632	14,913,868	4,013
50 - 99	67	304,701	4,230	11,782,560	5,468
100 - 500	35	157,850	5,107	27,028,000	9,897
>500	1	11,000	800	7,000,000	8,750
Unknown number	47	19,810	0	4,042,500	0
Total	772	915,774	20,496	70,286,636	6,229

[1]Number of responses in parentheses.

Total number of customers served weekly, by the 627 markets responding, was almost 916,000. Of these, 81 percent visited markets that serve between 20 and 500 farmers. Almost three-quarters of market managers responding report that the trading area for attracting consumers is less than 10 miles.

As the size of the market increases, so does the distance the farmer is willing to travel. For example, among markets serving 1 to 9 farmers, 54 percent of farmers drive 11-50 miles but among markets serving 50 to 99 farmers, 84 percent of farmers do so.

Most customers purchase from six or fewer vendors, even in large markets that serve many farmers. Over 80 percent of the managers who responded said that most customers visit two to five vendors each time they shop at the market.

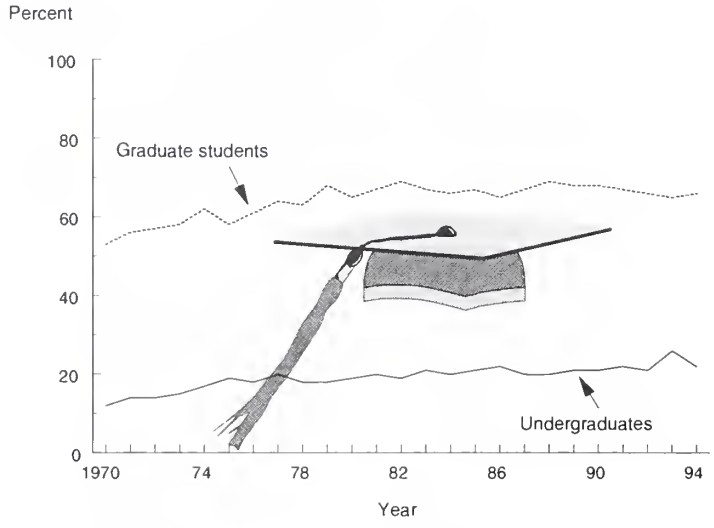
The market sales question in this survey had one of the lowest response rates (382), implying that many managers cannot estimate the dollar sales of their markets. It appears that managers measure the success of their markets by their ability to attract farmer and customer participation. The average sales per farmer trend upward through market-size categories 10 to 19, 20 to 49, 50 to 99, and 100 to 500. This indicates that more vendors will attract more customers than proportional to the size of the market. The table shows three shaded market categories. These represent only 43 percent of the responding markets. However, they account for 76 percent of total sales, 78 percent of total farmers served, and 81 percent of reported weekly customer visits.

Future research by USDA will seek to determine which demographic variables will yield a subset of most likely users of farmers' markets. Results will be added to the information gathered in this report and used to develop a data base that will assist States and localities in expanding existing markets and in planning future markets.

Source: Burns, A.F., 1996, *Farmers' Markets Survey Report*, U.S. Department of Agriculture, Agricultural Marketing Service.

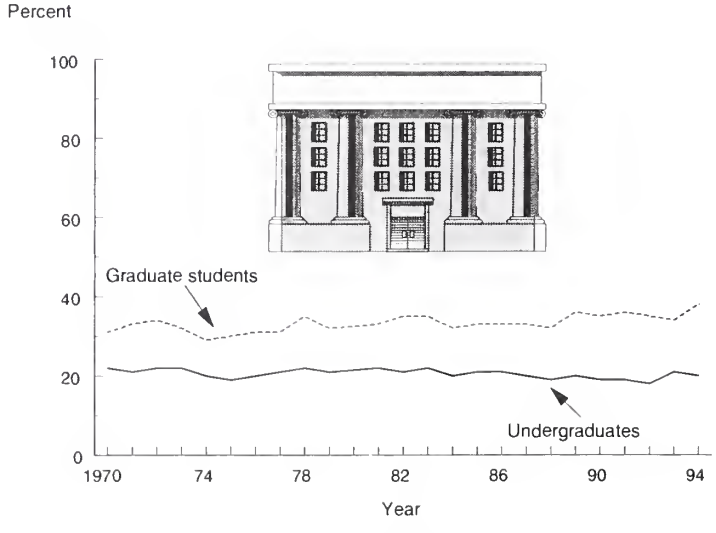
Charts From Federal Data Sources

Proportion of college students who are over age 25: 1970-94



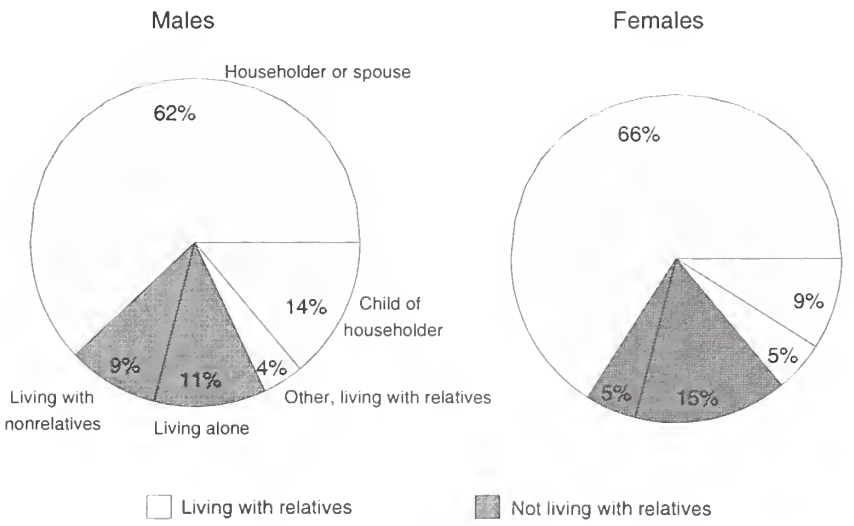
Source: U.S. Department of Commerce, Bureau of the Census, Current Population Survey.

Proportion of college students attending private institutions: 1970-94



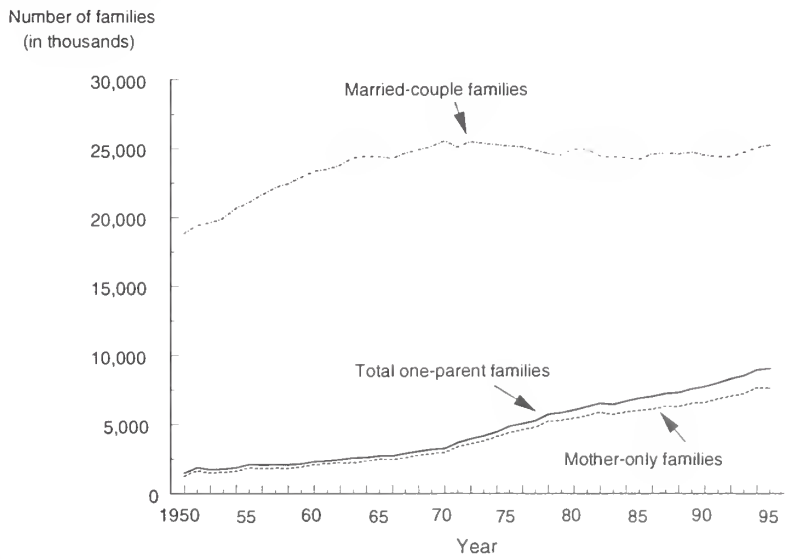
Source: U.S. Department of Commerce, Bureau of the Census, Current Population Survey.

Living arrangements of adults 18 years and older: March 1995



Source: U.S. Department of Commerce, Bureau of the Census.

Families with own children under 18 years old: 1950-95



Source: U.S. Department of Commerce, Bureau of the Census.

Research and Evaluation Activities in USDA

From the Office of Analysis and Evaluation, Food and Nutrition Service

The Office of Analysis and Evaluation, Food and Nutrition Service, reports on five studies of interest to the nutrition-related community.

Food Retailers in the Food Stamp Program: Characteristics and Service to Participants

A widely held concern is that food stamp families do not have the same degree of access to reasonably priced nutritious food as do families with higher incomes. According to a new report released by the Food and Nutrition Service (FNS), proximity to supermarkets and large groceries that sell a wide range of reasonably priced food is about the same for the population in poverty as for the general population. The study "Food Retailers in the Food Stamp Program: Characteristics and Service to Participants" finds that in most parts of the country, the low-income population can find supermarkets and large groceries that stock a wide selection of foods that meet quality standards at reasonable prices. Other kinds of stores fill market niches when needed.

Findings are based on analyses of a market basket of foods from a nationally representative sample of almost 2,400 retailers authorized by the Food Stamp Program (FSP). In addition, the complete national listing of all 200,000 food retailers authorized by the FSP was analyzed by location.

A number of observers have focused on access to food in poor urban neighborhoods. The study finds that the number of supermarkets and large grocery stores is slightly lower in high-poverty urban areas than in other urban areas, and supermarkets offer fewer full-service departments or nonfood product lines. However, the unique contribution of this study is to show that there appears to be little effect on the cost, selection, or quality of food. The study shows that the mix of stores in high-poverty urban areas is characterized by an extraordinarily high abundance of small groceries with less variety and higher prices than supermarkets. However, supermarkets exist in those same high-poverty urban areas and, based on actual food stamp redemption data, food stamp participants spend the vast bulk of their benefits at supermarkets, and the prices they pay to purchase a market basket are comparable to prices at supermarkets in low-poverty urban areas.

An additional concern has been access to food in rural areas. About 40 percent of the rural population resides in localities without supermarkets or large groceries. However, this appears to reflect the economics of food retailing, and there are few differences between high-poverty and low-poverty rural areas in either the cost or availability of food.

Evaluation of the Expanded EBT Demonstration in Maryland: Special Studies—Volume I. Patterns of Food Stamp and Cash Welfare Benefit Redemption

This report examines the frequency and timing of withdrawals of food stamp and cash benefits. The findings come from an analysis of a large data set containing information about how food stamp and cash welfare recipients access their benefits through Maryland's statewide electronic benefit transfer (EBT) system. The data set included the EBT systems' electronic record of the redemption activity of approximately 130,000 food stamp recipients and 75,000 recipients of cash assistance for the month of September 1993. These data were supplemented with FNS administrative data on store types to develop a unique descriptive picture of how program participants redeem their benefits over a month's time.

The analysis shows that recipients withdraw benefits from their food stamp account slightly more than 10 times per month and use their benefits at four or five different FSP-authorized stores.

Outside Baltimore City, 44 percent of cases use their EBT food stamp benefits exclusively at supermarkets, and only 2.5 percent of cases never use supermarkets. Over 80 percent of benefits are spent in supermarkets in these areas. In Baltimore City, where supermarkets represent only 6 percent of authorized stores, only 13 percent of food stamp cases use EBT benefits exclusively in supermarkets, and nearly 10 percent

never redeem in supermarkets. Baltimore has a system of well-stocked highly respected public markets that draws redemptions away from supermarkets. However, even in Baltimore City, slightly more than 60 percent of food stamp benefits, overall, are spent in supermarkets.

Both food stamp and cash benefit accounts are rapidly depleted. Nearly 23 percent of all food stamp benefits are spent on the day they become available, and 71 percent are redeemed within a week. Over 60 percent of cash benefits are withdrawn the first day they become available, and 91 percent within the first week. About 20 percent of both food stamp and cash benefit accounts have a positive balance at the end of the month. The average balance carried over in these accounts is $24 for food stamps and $35 for cash benefits.

Evaluation of the Expanded EBT Demonstration in Maryland: Special Studies—Volume II. Food Store Access and Its Impact on the Shopping Behavior of Food Stamp Households

This volume analyzes the same data set used in Volume I, supplemented by information on the geographic location of FSP households and FSP-authorized retailers. Measures of distance between households and retailers were developed using Geographic Information System (GIS) software. Shopping destinations, identified from the EBT transactions file, were then used to map a household's shopping trips and estimate distances traveled for food shopping.

Overall, 85 percent of all FSP households in Maryland have at least one FSP-authorized store within 1/2 mile of where they live. In Baltimore City, 99 percent are within 1/2 mile of a retailer; in other metropolitan counties, 71 percent; and in nonmetro counties, 62 percent.

The closest authorized store is likely to be a convenience or a grocery store. In Baltimore City, a grocery store is nearest for most FSP households. In other metropolitan and nonmetropolitan areas, convenience stores are likely to be nearest. However, FSP households redeem only a small percentage of food stamp benefits at the nearest retailer. This percentage ranges from 5.8 percent in Baltimore City to 10.4 percent in nonmetropolitan counties.

Food stamp households shop selectively and frequently bypass the nearest store. For the average FSP household, the nearest store is 0.3 miles. Yet, estimated travel distance for the average shopping occasion is 2.7 miles. This pattern of bypassing the closest store holds for all store types—supermarkets, grocery stores, convenience stores, or other types.

Although the large majority of households travel less than 3 miles to shop at a supermarket, there are areas throughout the State where the travel burden is more substantial. Nearly every county outside the Baltimore and Washington, DC metropolitan areas has at least one zipcode area where FSP households travel, on average, more than 10 miles to shop at a supermarket.

Food shopping behavior in Maryland is significantly affected by proximity to stores. Distance to the nearest supermarket has the biggest impact on shopping patterns, though the measured effect is small. For instance, a 10-percent increase in distance to the nearest supermarket reduces the share of EBT benefits redeemed at supermarkets by 1.3 percent in Baltimore and 0.8 percent elsewhere. Households with children redeem a larger share of their benefits at supermarkets and, in Baltimore City, elderly households spend more of their benefits at grocery stores.

Food Stamp Program Participation Rates: January 1994

The U.S. Department of Agriculture's Food and Nutrition Service recently released a report of the latest participation rates for the Food Stamp Program, *Food Stamp Program Participation Rates: January 1994.* The participation rate—the proportion of those eligible for food stamps who actually apply for and receive benefits—is a valuable policy tool that shows whether the program is reaching the intended population and which groups of the eligible population participate at higher or lower rates than other groups.

The report shows that in January 1994, rates remained at or near their highest point since the beginning of the series in 1985. Between January 1992 and January 1994, the FSP participation rate for eligible households held steady at 69 percent. Participating households received 81 percent of total potential food stamp benefits in January 1994, similar to the 82 percent in January 1992. Although the overall household participation rate did not change, the participation rate for one-person households increased while the rate for larger households fell. Consequently, the per person participation rate declined slightly, from 74 percent in 1992 to 71 percent in 1994.

Other findings include:

- *Almost all eligible children participated, but only one in three eligible elderly persons participated.* The FSP served almost every eligible child under the age of 5 (93 percent) and most children under age 18 (80 percent), but it served only 35 percent of eligible elderly.
- *African Americans participated at higher rates than other racial/ethnic groups.* Eligible households headed by African Americans were more likely to participate (94 percent) than households headed by Hispanics (63 percent) or White non-Hispanics (60 percent).
- *Single-parent households participated at a higher rate than other types of households.* Households containing a single parent with children were more likely to participate (97 percent) than households containing multiple adults and children (73 percent).
- *The lower the income, the higher the participation rate.* The FSP participation rate for households with monthly income below the poverty line was 87 percent, compared with 21 percent for households with income above the poverty line.
- *The higher the benefit, the higher the participation rate.* Only 23 percent of households eligible for the minimum benefit of $10 participated, compared with 89 percent of those eligible for more than $150.
- *Households receiving AFDC were more likely to participate than those with earnings or unemployment compensation.*
- *Among the 29 percent of all eligible individuals who did not participate, most were elderly persons, lived in households headed by a White non-Hispanic, lived in households with income above the poverty line, and/or were in households eligible for the lowest benefits.* Over half of eligible nonparticipating households had earned income, compared with only 21 percent of participating households.

Feasibility of Food Price Monitoring in Rural Areas

This report examines feasible alternatives for developing a routine food price collection system in rural areas. Such a system would allow USDA to compare food price changes in rural areas of the United States with changes in urban areas as currently captured by the food-at-home component of the Consumer Price Index (CPI). A rural-food-price index would provide USDA with an important tool for monitoring food-purchasing conditions in rural areas. The index would also allow FNS to monitor an important component of the rural populations' relative access to affordable, nutritious food.

Four alternatives were investigated. Each alternative requires a representative survey of shopping patterns by rural households; sampling of stores and pricing of specific food products; and recruitment and training of a field staff for bi-monthly price collection. Three of the four alternatives are based on a strict replication of the procedures currently used to produce the CPI food-at-home index. A fourth alternative, using price data from electronic scanners, would require price collection and index construction for both urban and rural areas in order to make valid comparisons. This fourth alternative was not considered to be feasible.

Ordering Information

The above reports are available by calling the National Technical Information Service at (703) 487-4650. Individuals with a secure web browser may point to http://www.ntis.gov/ to order the reports online.

Cost of Food at Home

Cost of food at home estimated for food plans at four cost levels, September 1997, U.S. average[1]

Sex–age group	Cost for 1 week				Cost for 1 month			
	Thrifty plan	Low-cost plan	Moderate-cost plan	Liberal plan	Thrifty plan	Low-cost plan	Moderate-cost plan	Liberal plan
FAMILIES								
Family of 2:[2]								
20 - 50 years	$56.90	$71.70	$88.70	$110.10	$246.50	$310.90	$384.20	$477.30
51 years and over	53.60	69.00	85.40	102.30	231.80	299.10	369.90	443.40
Family of 4:								
Couple, 20 - 50 years and children—								
1 - 2 and 3 - 5 years	82.60	103.30	126.40	155.30	358.20	447.60	547.90	673.40
6 - 8 and 9 - 11 years	95.00	121.60	152.00	182.90	411.80	527.10	658.40	792.80
INDIVIDUALS[3]								
Child:								
1 - 2 years	14.80	18.20	21.20	25.70	64.30	78.70	92.00	111.50
3 - 5 years	16.10	19.90	24.60	29.50	69.80	86.30	106.60	128.00
6 - 8 years	19.80	26.40	33.00	38.30	85.80	114.50	142.90	166.10
9 - 11 years	23.50	30.00	38.40	44.50	101.90	130.00	166.20	192.80
Male:								
12 - 14 years	24.40	33.90	42.00	49.50	105.50	146.90	182.00	214.40
15 - 19 years	25.20	35.00	43.50	50.40	109.20	151.50	188.50	218.30
20 - 50 years	27.20	34.70	43.50	52.70	117.90	150.40	188.60	228.30
51 years and over	24.60	33.20	40.90	49.10	106.40	143.90	177.30	212.70
Female:								
12 - 19 years	24.40	29.20	35.40	42.70	105.60	126.50	153.30	185.20
20 - 50 years	24.50	30.50	37.10	47.40	106.20	132.20	160.70	205.60
51 years and over	24.10	29.50	36.70	43.90	104.30	128.00	159.00	190.40

[1]Assumes that food for all meals and snacks is purchased at the store and prepared at home. Estimates for the thrifty food plan were computed from quantities of foods published in *Family Economics Review* 1984(*1*). Estimates for the other plans were computed from quantities of foods published in *Family Economics Review* 1983(*2*). The costs of the food plans are estimated by updating prices paid by households surveyed in 1977–78 in USDA's Nationwide Food Consumption Survey. USDA updates these survey prices using information from the Bureau of Labor Statistics, *CPI Detailed Report*, table 4, to estimate the costs for the food plans.

[2]Ten percent added for family size adjustment. See footnote 3.

[3]The costs given are for individuals in 4-person families. For individuals in other size families, the following adjustments are suggested: 1-person—add 20 percent; 2-person—add 10 percent; 3-person—add 5 percent; 5- or 6-person—subtract 5 percent; 7- or more-person—subtract 10 percent.

Consumer Prices

Consumer Price Index for all urban consumers [1982-84 = 100]

Group	Unadjusted indexes			
	September 1997	August 1997	July 1997	September 1996
All items	161.2	160.8	160.5	157.8
Food	157.9	157.6	157.0	154.6
Food at home	158.6	158.5	157.7	155.9
Food away from home	157.8	157.4	157.1	153.5
Housing	157.7	157.6	157.5	153.9
Shelter	177.2	177.5	177.0	172.0
Renters' costs[1]	186.8	189.1	188.4	180.9
Homeowners' costs[1]	182.8	182.2	181.7	177.5
Household insurance[1]	166.8	166.3	165.7	162.3
Maintenance and repairs	142.6	145.5	145.4	139.9
Maintenance and repair services	150.2	154.4	153.8	147.4
Maintenance and repair commodities	132.1	133.1	133.7	129.5
Fuel and other utilities	132.1	131.4	132.1	129.8
Fuel oil and other household fuel commodities	93.7	93.5	94.7	95.6
Gas (piped) and electricity	128.1	126.7	127.8	126.2
Household furnishings and operation	125.4	125.2	125.6	125.1
Housefurnishings	110.2	110.2	110.7	111.5
Apparel and upkeep	133.0	130.0	130.2	131.5
Apparel commodities	129.2	125.9	126.2	127.8
Men's and boys' apparel	131.4	128.9	128.0	127.4
Women's and girls' apparel	126.0	120.3	121.1	123.6
Infants' and toddlers' apparel	126.7	127.3	131.3	131.4
Footwear	127.4	126.3	125.9	126.7
Apparel services	163.7	163.6	163.5	160.4
Transportation	144.3	143.8	143.7	143.2
Private transportation	141.0	140.8	140.1	140.0
New vehicles	142.7	143.0	143.7	143.2
Used cars	148.2	148.5	149.9	157.0
Motor fuel	109.3	107.6	103.9	106.2
Maintenance and repairs	163.5	163.3	162.9	160.0
Other private transportation	176.9	177.4	177.5	174.1
Public transportation	186.0	183.4	189.4	184.6
Medical care	235.4	235.2	234.8	229.4
Medical care commodities	215.3	215.5	216.0	211.2
Medical care services	240.0	239.8	239.2	233.6
Professional medical services	216.4	216.3	215.9	209.6
Entertainment	163.0	163.0	162.6	159.8
Entertainment commodities	144.7	144.6	143.8	143.3
Entertainment services	184.2	184.3	184.5	179.1
Other goods and services	228.1	225.7	223.5	218.3
Personal care	152.7	152.5	152.6	150.8
Toilet goods and personal care appliances	143.7	143.5	143.7	145.1
Personal care services	162.8	162.7	162.5	157.2
Personal and educational expenses	264.9	261.6	258.0	252.1
School books and supplies	241.5	240.0	237.7	229.9
Personal and educational services	266.9	263.5	259.8	254.0

[1]Indexes on a December 1982 = 100 base.

Source: U.S. Department of Labor, Bureau of Labor Statistics.

Index of Articles in 1997 Issues

*Indicates article was abstracted from another source.

Index of Authors in 1997 Issues

Family Economics and Nutrition Review
gratefully acknowledges the reviewers of manuscripts for 1997 issues.

Norman E. Bednarcyk
Nabisco, Inc.

J. Benedict
University of Nevada, Reno

Alma J. Blake
University of Maryland, College Park

Muriel Brink
Cornell University

Guendaline Brown
West Virginia Extension Service

Ritva Butram
American Institute for Cancer Research

Catherine M. Champagne
Pennington Biomedical Research Center

Nancy M. Childs
St. Joseph's University, Philadelphia

Linda Cleveland
Agricultural Research Service
U.S. Department of Agriculture

Nancy Crane
Food and Drug Administration
U.S. Department of Health and Human Services

Elizabeth Frazao
Economic Research Service
U.S. Department of Agriculture

Steve Garasky
Iowa State University, Ames

Amy Green
Westat Research Company, Inc.

Patricia Guenther
Agricultural Research Service
U.S. Department of Agriculture

Pamela S. Haines
The University of North Carolina at Chapel Hill

Charlene Hamilton
University of Delaware, Newark

Rudolph Harris
Food and Drug Administration
U.S. Department of Health and Human Services

Gail Harrison
University of California, Los Angeles

Janice Hermann
Oklahoma State University, Stillwater

Myrtle Hogbin
Center for Nutrition Policy and Promotion
U.S. Department of Agriculture

Mark Hudes
University of California, Berkeley

Linda Kantor
Economic Research Service
U.S. Department of Agriculture

Susan Krebs-Smith
National Cancer Institute
U.S. Department of Health and Human Services

L. Lytle
University of Minnesota, Minneapolis

Deanna Montgomery
University of Texas, Houston

Rebecca Mullis
Georgia State University

Suzanne Murphy
University of California, Berkeley

T. A. Nicklas
Tulane Center for Cardiovascular Health

Victor Oliveira
Economic Research Service
U.S. Department of Agriculture

Grace Petot
Case Western Reserve University

Dorothy Z. Price
Washington State University, Pullman

Linda Snetselaar
University of Iowa, Iowa City

Phyllis Stumbo
University of Iowa, Iowa City

Katherine Tucker
USDA Human Nutrition Research Center at Tufts

Order Processing Code:
*** 5141**

Superintendent of Documents Order Form

Charge your order.
It's Easy!
To fax your orders (202) 512-2233

☐ **YES,** enter my subscription as follows:

____ subscriptions to **FAMILY ECONOMICS AND NUTRITION REVIEW (FAMER)** for $10.00 per year ($12.50 foreign).
(**NOTE**: Formerly **FAMILY ECONOMICS REVIEW**)

The total cost of my order is $_____. Price includes regular domestic postage and handling and is subject to change.

_____
(Company or personal name) (Please type or print)

_____
(Additional address/attention line)

_____
(Street address)

_____
(City, State, ZIP Code)

_____
(Daytime phone including area code)

_____
(Purchase Order No.)

For privacy protection, check the box below:

☐ Do not make my name available to other mailers.

Please choose method of payment:

☐ Check payable to the Superintendent of Documents

☐ GPO Deposit Account ☐☐☐☐☐☐☐-☐

☐ VISA or MasterCard Account

☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

☐☐☐☐ (Credit card expiration date)

Thank you for your order!

_____
(Authorizing Signature)

Mail to: New Orders, Superintendent of Documents
P.O. Box 371954, Pittsburgh, PA 15250-7954

Center for Nutrition Policy and Promotion
U.S. Department of Agriculture

Access CNPP's home page at: http://www.usda.gov/fcs/cnpp.htm

Below are the options you will see.

- What's New at CNPP
- About CNPP
- The Mission of the CNPP
- FCS Library of Files (includes CNPP files)
- Nutrition Insights. From the Center for Nutrition Policy and Promotion
- Expenditures on Children by Families, 1995 and 1996 Annual Reports
- Healthy Eating Index
- Food Guide Pyramid
- Cost of Food at Home at Four Cost Levels: May 1996--November 1997
- Report of the Dietary Guidelines Advisory Committee on the Dietary Guidelines for Americans, 1995
- 1995 Dietary Guidelines
- Using The Food Guide Pyramid: A Resource for Nutrition Educators

For more information, contact:
USDA, Center for Nutrition Policy and Promotion
1120 20th Street NW, Suite 200 North Lobby
Washington, DC 20036
Phone: (202) 418-2312

Guidelines for Authors

Family Economics and Nutrition Review is a peer-reviewed quarterly journal published by the Center for Nutrition Policy and Promotion; Food, Nutrition, and Consumer Services; U.S. Department of Agriculture.

Family Economics and Nutrition Review follows the guidelines of the *Publication Manual of the American Psychological Association*, Fourth Edition.

1. Manuscripts may not be submitted elsewhere while under consideration by the *Review*.

2. To ensure anonymity, include a separate title page with author's full name, title, affiliation, full address, and telephone number. There should be no reference to the authors in the text or footnotes.

3. Manuscripts should be double-spaced, on 8-1/2" x 11" paper, have 1-1/4" margins, and use 10 or 12 pitch type size.

4. Manuscripts should include an abstract of no more than 150 words.

5. Abstract, text, references, tables, and figures should not exceed 30 pages.

6. Each table or figure should be placed on a separate page.

7. Upon acceptance, authors must send a 3-1/2" computer disk copy of the final accepted version of the manuscript in WordPerfect 7.0 or lower. Disks and manuscripts will not be returned.

8. All authors and coauthors must sign a release acknowledging that contents of the *Review* are in the public domain.

9. Please send four copies to:

   Jane Fleming, Managing Editor
   Family Economics and Nutrition Review
   USDA, Center for Nutrition Policy and Promotion
   1120 20th Street, NW, Suite 200 North Lobby
   Washington, DC 20036
   (202) 606-4816